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Europe

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ADVANCED MATERIALS

Conductive Plastic at FRG's Max Planck Institute

36980276c Duesseldorf VDI NACHRICHTEN in German 13 Apr 88 p 22

[Text] 1 Apr, Kaem—The Max Planck Institute for Polymer Research in Mainz, Bayreuth University, and the BASF chemical concern have jointly developed a new polyacetylene that has a conductivity comparable to metals.

These polyacetylenes, with an alignment of fibers and a high degree of crystal structure in the fibers, have a conductivity amounting to about 120,000 mhos/cm and thus are even more conductive than iron. Although copper has a conductivity of 650,000 mhos/cm, if considerations are based on the fact that the specific density of the new polyacetylene is only 1.55 g/cm^3 whereas the specific density of copper is 8.93 g/cm^3, this comes to a density-specific conductivity of 72,000 for copper but 100,000 for polyacetylene.

Following polymerization, the material is acted on by reducing substances; subsequently the fibers are stretched out by as much as 600 percent, whereupon the plastic conductor shows its special capability only in the direction of the fibers, but this anisotropy can also be advantageous.

Dr Herbert Naarman of BASF Plastics Research in Ludwigshafen regards the following to be further applications for these electrically conductive polymers: Flexible conductor tracks, heating foils, and—because of their restorative power—push-button switches.

12114

AEROSPACE, CIVIL AVIATION

West Europeans Debate Manned Space Flight

Strasbourg Symposium

36980277 Paris LIBERATION in French 27 Apr 88 p 28

[Article by Dominique Leglu, special correspondent: "Safety in Space: Researchers Keeping Their Feet on the Ground"; first paragraph is LIBERATION introduction]

[Text] Strasbourg—Meeting at Strasbourg, the decision-makers of the large Western space programs have explored the different options for placing man in orbit in complete safety. The first tests will be before the year 2000.

If it were necessary to specify the major themes of the International Symposium of Europe in Space dedicated to the manned flight system which began Monday, 25 April and continues through next Friday in Strasbourg, they would be "cohesion and safety." Meeting there are not only the experts on the Ariane European rocket (especially on the next generation Ariane 5) but also all those involved in defining the future Hermes space plane and the European Columbus orbital station—not to mention a few high-level representatives from the United States, Japan, and China.

Although invited, the Soviets did not attend, apparently too busy with preparations for the launch of their own space shuttle. In all, more than 500 persons directly involved in the design of Europe's space efforts during the next 10 or even 20 years are in attendance.

Last 9 and 10 November in The Hague, the decision was made by the ministers of research and industry of the ESA countries to construct all the pieces of the European puzzle. This symposium, 6 months later, is the first meeting for actual work on the European space program. Communication, as thorough as possible, has become an absolute necessity for the coherence of the ESA [European Space Agency] program. This is an infrastructural need felt even within certain countries. Following the lead of France which established CNES [National Center for Space Research] to play the role of mediator and coordinator between government and the space industry, Italy and the FRG are considering setting up a comparable structure.

Cohesion? Certainly. But to do what? Given the decisions made at The Hague, there is no turning back from the European choice of placing astronauts in orbit before the end of the century. This does not keep the experts from focusing critical attention now on a key problem: that of the safety of the future astronauts.

More than 2 years have passed since the tragedy of the American Challenger shuttle which caused the death of seven astronauts.

As with the Three Mile Island nuclear accident, which forced the Western nuclear establishment to review its facilities, reflection on safety has moved forward considerably without any clear option gaining support of all involved—technicians and astronauts.

It is no coincidence that, during these first 2 days of the symposium, there have been numerous references to the recent report of the French Academy of Sciences, "Research and Space Policy in the Coming Decades." Beginning with its first page, it poses the important question: "Should the immediate future of our country's space research program take the form of a priority effort focusing on manned flights or, on the other hand, would it be better to dedicate most of the funds during the coming years to the development of automated space experiments using 'robot' satellites?" Rather than juxtaposing man and robot, many European decisionmakers prefer to view this issue as a warning. Reimar Luest, head of ESA, said at the outset: "Man must only be used where he is indispensable." And Frederic d'Allest, head

of CNES, insisted on the fact that "25 percent, not more, of the financing offered by CNES" is for the actual manned portion of the project.

Man in orbit is expensive, he makes it necessary to immediately establish a "real safety strategy." The equipment has to be virtually perfect, for example, rocket reliability must approach 100 percent. When Ariane 5 transports Hermes, it must be 99 percent safe—compared to 98 percent reliability for an Ariane 5 carrying an automated satellite. This single small percentage point makes it imperative to increase ground tests (several hundred). Hermes also must be equipped with a system of ejectable cabins which would permit the astronauts to escape in the event of a problem during certain phases of the flight; this solution however has not yet received unanimous acceptance. And this does not even take into account the preliminary reflections now in progress concerning safety on the international space station. Thus, as Frederic d'Allest has suggested, a Hermes craft could always be docked at the station to permit a possible rapid evacuation, for example, in the event of unexpected depressurization caused by meteorite impact.

For their part, the Italians, making a very strong showing at Strasbourg since becoming the third European space power following the withdrawal of the UK, are fiercely defending the EDRS [European Data Relay Satellite] project. It is clear that, with 40 percent participation, they want to manage this project valued at 700 million ECU (approximately Fr5 billion). EDRS is supposed to be a system of two geostationary satellites guaranteeing high-flow communication between the ground stations and the elements in flight or in orbit (Hermes, Columbus).

This is one requirement for safety which presupposes very advanced technical mastery. "Satellites and automated probes have constituted the principal tools of space research and applications until now" notes the Academy of Sciences in its report. And, the Academy points out, "In space systems, the amount of electronics has not stopped growing—approximately 10,000 components per satellite in 1970, 100,000 in 1980, 1 million for the next decade, etc. It is not impossible that in the year 2000 a Cray 1 (supercomputer) could be placed on a single card."

All of this will not fail "to completely revolutionize our ideas of data storage, of on-board processing and management." Not to mention the obvious impact on the capabilities of future robots. The report mentions that the "United States plans construction, before the end of the century, of the FTS [Flight Telerobotic System], since Congress has required NASA to install it on the future space station." It is supposed to be capable of assembling the station, wiring it, modifying its solar panels, etc. And beginning in 1998, NASA plans to use it for maintaining platforms.

Obviously, Europe, which has just committed to putting man in space, following the lead of the Soviet Union and the United States, cannot neglect this "robot" orientation. The equilibrium to be maintained between man and robot will be one of the challenges of the European space program during the final part of this century.

French Academy of Sciences Report

36980277 Paris LES ECHOS in French 22 Apr 88 p 33

[Article by Olivier Postel-Vinay: "Hermes Disputed"; first two paragraphs are LES ECHOS introduction]

[Text] Top level French scientists dispute the interest for Europe of sending men into space.

"The 'man in space' option cannot be justified, given the current cost estimate, by arguments which are purely scientific or which involve industrial and commercial applications."

This is the conclusion of a group of high level experts brought together two years ago under the initiative of the Academy of Sciences. The group, which is to continue its work, is chaired by Prof Raimond Castaing, former head of ONERA [National Office for Aerospace Studies and Research]. Noteworthy members are two former heads of CNES, Hubert Curien and the astronomer Francois-Jean Denisse; Jean-Pierre Causse and Eric Spitz, who direct research for Saint-Gobin and Thomson, respectively; Roger Chevalier, vice president of SNIAS [National Society of the Aeronautics and Space Industries]; Pierre Faurre, CEO of Sagem and member of the Science and Defense Council; Prof of Medicine Jean Hamburger, of the Academy of Sciences; and numerous experts of the major disciplines involved.

This is the first time that a group of French experts has publicly revealed that the Hermes project is deeply dividing the French scientific community.

The Academy of Sciences emphasizes that it "fully adopts" the conclusions of this report. However, it must be noted that this is not a statement of complete hostility with regard to the Hermes project. Certain members of the committee, obviously in the minority, nevertheless favor the project. Their reasons are not scientific, technical, or commercial. For, in the final analysis, in the opinion of the committee, the decision to launch a manned space flight project is political.

These are the major arguments raised:

—**Astronomy:** In satellites, instruments must be placed in a parasite-free environment. The presence of humans is undesirable.

—**The Study of the Earth:** Here again, automated satellites are "perfectly appropriate."

—**Microgravity:** Accelerations caused by the astronauts disturb most experiments.

—**Biology:** Some of the experiments can be performed using automated devices.

—**Human Physiology:** The interest of studies in weightlessness does not justify sending men into space, especially for periods as short as those planned by the European project.

—**Telecommunications, Navigation, etc.:** Automated satellites are quite appropriate.

—**Repairs in Space:** Satellite maintenance is more and more automatic thanks to the reliability, service life, and redundancy of on-board systems. Furthermore, most scientific or applications satellites could hardly be visited by man since they circulate in orbital regions inaccessible to man because of radiation. For that matter, the architecture of most current satellites makes any complex repair impossible.

—**Technical Spin-offs:** To date, applications of space technologies to other fields have been the result of fortunate coincidences. These have been unexpected spin-offs rather than the result of deliberate technological policy.

Generally speaking, the report emphasizes that advances in electronics, data processing, and robotics, which can only continue, argue in favor of increasing efficiency of automated means. Thus, before the end of the century, the United States expects to construct the FTS robot for use in construction of the space station.

In conclusion, the authors of the report feel that the Hermes project threatens to take money away from scientific research.

12666

More On Strasbourg Symposium

36980278a Frankfurt/Main FRANKFURTER ALLGEMEINE in German 30 Apr 88 p 7

[Article by Anatol Johansen: "First Manned Space Flight of Europeans Before the Turn of the Century? International Symposium in Strasbourg, Hermes and Ariane 5, Astronaut Training Sites"]

[Text] Strasbourg, 29 Apr—The new European Ariane 5 rocket, heavier than 700 metric tons and 47 meters long, whose construction the member countries of the European Space Agency ESA agreed to in November of last year at The Hague, is to undergo its first flight tests in 1995. Flight A 501 is to be launched early in the year; flight A 502 toward the end of the year. Then, in 1996 commercial operation will begin with the rocket, which can simultaneously transport two or three heavy satellites with a total weight of more than 6 metric tons into geostationary orbit at an altitude of 36,000 km. Then, in 1998, the small European space plane Hermes—still unmanned—will be launched for the first time on the Ariane 5. That will conclude the development of the largest rocket ever undertaken in Europe. Only after that, or roughly in the year 1999, will three West European astronauts be able to go into space independently of the two superpowers for the first time in the history of space flight in the Hermes space plane on the Ariane 5.

Director Feustel-Buechl, the person in charge of the ESA space transport system, just made all of these announcements in Strasbourg. He was reporting at a 1-week symposium on West European manned space flight organized by the research ministries of the FRG, France, and Italy along with ESA and attended by 600 participants from government, science, and industry. The symposium ended on Friday.

From the opening of the symposium ESA Director Luest indicated that, Ariane and Hermes notwithstanding, manned space flight could in no way be considered an end in itself. To the contrary, ESA would only use men where absolutely necessary—in contrast to the American NASA—and would otherwise work with automated devices.

In fact, the manned space plane Hermes is still giving the Europeans some headaches. Following the explosion of the American Challenger shuttle in January 1986, it was decided to equip Hermes with an astronaut rescue system for the launch phase. This reduced the payload of the space plane from the 6-metric-ton maximum originally planned to 3 metric tons at best. This also means that only three astronauts can travel into space with the shuttle, rather than as many as six. However, it became clear at Strasbourg that nothing has been settled yet in the Hermes project.

German astronaut Merbold, who flew in 1983 as the first non-American in the European Spacelab on board the American shuttle and is now head of the German Astronaut Agency, reported in Strasbourg that a training center for European astronauts is being built in Cologne-Porz at the German Research and Testing Facility for Aeronautics and Astronautics (DFVLR). All West European astronaut candidates are to be trained there. There will however be other training sites. For example, the pilots who will someday fly the European space plane will go from Cologne-Porz to Toulouse for special space pilot training. A Hermes simulator, on which the shuttle pilots can train, will be built in Brussels. Likewise, there is a water tank in Marseille in which the astronauts can train underwater—as a simulation of weightlessness.

FRG Federal Research Minister Riesenhuber stated that Europe must participate in manned space flight for scientific, political, and commercial reasons. This view was shared by Italian Minister for Scientific Research Ruberti. He stated that Italy had, for this reason, increased its space budget from 1982 to 1988 by 450

percent to 400 billion Lire. The French company Aerospatiale presented among other things the STEAMS [Study Towards European Autonomous Manned Spaceflight] plan which has as its objective the construction of a European space station—expanding on the plan which provides for a European part of the American space station. According to the Aerospatiale experts, it could be ready for operation in the year 2010.

12666

Astronaut Base, Training Facilities

36980282 Paris LE FIGARO in French 25 Apr 88 p 32

[Article by Albert Ducrocq: "A Corps of 6 Astronauts"]

[Text] There are already half a dozen Europeans who have flown with the Soviets or the Americans. Europe would like to increase this small core, but opportunities are few.

The European Space Agency [ESA] has decided in favor of self-controlled manned flights: in 10 years, the Hermes shuttle will be launched by the Ariane-5 rocket so that astronauts will be able to visit the Pallas station from time to time, while the Columbus module will be manned permanently. That will require the creation of a European astronaut corps.

Judging from precedents, creating such a corps should not be a problem. In 1977, when the Europeans were hoping that several of them would fly on Spacelab, there were many candidates: no less than 453 declarations of intent in France, and 610 in Germany. It is safe to say that if recruiting were to resume today, applications would pour in.

But, precisely, the ESA does not intend to take such an initiative prematurely. Experience has shown that it is ill-advised to select astronauts if you can offer them no flight and no training, just a title, while asking them to go on with their usual occupations.

As a result, there will be two stages. For the time being, to design equipment and programs, the Europeans can rely on the experience of six men who have already flown. They are, in the chronological order of their missions: Jean-Loup Chretien (8 days in space in June 1982, with Soyuz T6 which rendezvoused with Saliut 7); Ulf Merbold (10 days in November-December 1983, on the Columbia shuttle which carried Spacelab 1); Patrick Baudry (7 days in June 1985 on board Discovery); Wubbo Ockels, Ernst Messerschmid and Reinhard Furrer (7 days in October- November 1985; these three astronauts were part of the Columbia crew during the flight made by Spacelab under German flag).

Advisory Role

At the end of this year, we should either record Jean-Loup Chretien's second flight, with the French-Soviet Aragatz mission, or add a seventh name to the list of European astronauts if Michel Tognini were to be on that flight; Michel Tognini is currently in training at Cite des Etoiles, with Jean-Loup Chretien whose replacement he is.

In addition, Claude Nicollier—a Swiss astronaut who is now one of NASA's mission specialists—is expected to be on a shuttle flight devoted to earth resources in 1991.

That would bring to seven or eight the number of astronauts available to act as advisors in the preparation of future European missions, and at least one of them will fly on Hermes since it seems now certain that Patrick Baudry will be its first pilot, in 1998.

These men will also be responsible for the creation of a European astronaut group which is expected to be recruited in 1992 or 1993; the ESA considers that 5 years of training would be amply sufficient. Their preparation would of course include theoretical courses and training sessions using the new training resources acquired by the Europeans, and in particular training for excursions into space sponsored by COMEX in Marseilles.

However, it is also to be desired that most of these future astronauts complete their first flight before being assigned to specifically European missions. In addition, the National Center for Space Studies [CNES] would welcome flight opportunities for members of the seven-men team selected in 1985 from 716 candidates, which is known to include, besides Michel Tognini, Claudie Andre-Deshays, Jean-Jacques Favier, Frederic Patat, Michel Viso, Jean-Francois Clervoy (the youngest; born on 19 November 1958, he may well still be under 40 when Hermes flies), and Jean-Pierre Haignere.

And there is the rub. There was a time indeed when Soviets and Americans rivalled to invite as many foreign astronauts as possible on their space vehicles. The Russians thus flew cosmonauts from 12 countries under the Intercosmos program.

Special Treatment

However, if we are to believe their most recent statements, this policy could well end this year; 1988 would see the completion of the latest flights of this type with a second Bulgarian astronaut expected to fly in June, and an Afghan astronaut in August. Undeniably, the French benefit from special treatment: they are the only ones to whom the Russians have agreed to give a one-month flight (after considering a two-month flight); moreover, this flight should include a sortie into space. It is still too soon to mention a third, and a fortiori a fourth French-Soviet flight. But the trend in the USSR is toward near elimination of international flights together with a policy

of reduction of the number of launches. It looks as if, in their program of operation of the Mir orbital station, the Soviets had decided to send fewer and fewer men into space, but to leave them there longer and longer.

The trend is still more marked among the Americans. The number of shuttle missions in years to come has been the subject of constant revisions; it was decreased each time, with crews reduced to a minimum, and with no place offered to non-Americans. It is not even sure that the British astronaut Nigel Wood—who was to fly with an Indonesian woman (Pratini Soedarnomo)—will go into space. Yet, this Royal Air Force commander, which was to have been received by the corps of U.S. astronauts on 30 January 1986, met the schedule and did not hesitate to go to Houston 2 days after the Challenger disaster.

Certainly, the Europeans have several years ahead of them during which to negotiate future flights in a context which could be different in 5 years from now. Meanwhile, they are glad that so many of them had an opportunity to go into space.

9294

Plans for European Part in Space Station Solidify

36980283 Brussels LE SOIR in French 13 May 88 p 16

[Article by Jacques van Cutsem: "The Columbus Multiple Orbital Station"]

[Text] Coordination of studies and projects for building a European manned space system by the year 2000 have begun, covering three major programs—the powerful rocket Ariane V, the Hermes space plane, and the Columbus program—all of them stopped by the La Haye conference of last November. Columbus represents Europe's wish to cooperate in the international space station proposed by the United States. After more than two years of arduous negotiations, this wish resulted in a memorandum of agreement between the European Space Agency (ESA) and the American space agency NASA, to build this orbital station midway through the next decade.

The memorandum stipulates the "implementation of an intergovernmental agreement" among the United States, Europe, Canada, and Japan, concerning the "detailed design, development, exploitation, and utilization for peaceful ends, of a civilian, permanently manned, orbital station, in accordance with international law."

At a cost currently estimated to be $20 million, this station is known to include four modules attached to a long metal structure. It will have a housing module (built by the Americans) for astronauts and scientists, and three laboratory modules—American, Japanese, and European—called Columbus.

Modules and Platforms

But under the name Columbus, ESA designates four different units, the first and largest of which is known in the technical world as APM [Attached Pressurized Module]. This is the permanently manned pressurized laboratory module which will be "hooked up" to the international space station.

It is a cylindrical module with an empty weight of 15 t, a length of 12.8 m, and a diameter of 4.5 m, in which two or three people will work "in their shirtsleeves" with scientific equipment, to pursue research into the life sciences, fabricate materials under microgravity, as well as study fluid physics.

Placed in orbit by an American shuttle, this unit will be an integral part of the space station, in mid-1996 at the earliest.

The second unit, known as MTFF for Man-Tended Free-Flyer, is half as large as the APM (6 m long); it is a small automated and autonomous non-manned module, which can be visited by man. It will contain equipment necessary to carry out scientific experiments in microgravity, which are of long duration and require the absence of any disturbances; these involve research experiments, the fabrication of materials, or crystal growth in weightlessness.

The MTFF, considered as the basic unit of the future European space station, will be placed in orbit by an Ariane V around 1998. It will be visited periodically by the Hermes astronauts, who will provide its maintenance.

The two other units are fully automatic and can be manned. One, the Polar Platform (PPF), is a large, 13 t automatic unit, which in a heliosynchronous polar orbit at an altitude of about 850 km, is intended for the development of new instruments for Earth observation and study.

The other, called Eureca [European Retrievable Carrier], and not to be confused with Eureka, the program for new European technology, is a fully autonomous reusable mini-laboratory—a 4-ton instrument carrier—flying near the space station and performing six-month projects in microgravity. It will be deployed and recovered by the American shuttle, and brought back on the ground for service. If needed, the Hermes astronauts could repair it, or recover and return the results of various experiments.

Financing of 96 Percent

At the end of the La Haye conference, 8 of the 13 ESA member nations had assured their financial participation in the Columbus project, at a cost of about $5 billion, or Fr175 billion: FRG for 38 percent, Italy 25 percent, France 13.8 percent, Spain 6 percent, Belgium 5

percent, the Netherlands 1.3 percent, Denmark 1 percent, and Norway 0.4 percent. Five countries—Great Britain, Austria, Ireland, Sweden, and Switzerland—withdrew because of the high cost or due to neutrality problems.

In mid-April, the English reversed their position: Great Britain announced that it would participate with $475 million, representing 5.5 percent of the total Columbus program, but specifically in the construction of the polar platform, as a result of the modifications made to the latter's design in the meantime. By the same token, London withdrew all participation from the Canadian project Radarsat. The Columbus program is thus 96 percent financed at the present time.

New Delay

At the same time, it was learned that assembly of the international space station would not be completed until the end of 1996, which is a one year delay over the initial schedule. NASA explained that forced budget reductions had faced it with three alternatives: reduce the size of the station, entirely review the program, or lengthen the duration of its construction. For the NASA administrator, the last option was the "most sensible one."

The first units of the space station will therefore be placed in orbit only at the beginning of 1995, which is one year later than planned, and the station will be operational only at the end of 1996 or the beginning of 1997. The scientific and industrial world is disappointed to see delayed the moment when they might have a permanent space laboratory in which to carry out scientific research or study the production of materials and substances in many fields.

That is why the United States decided to build a smaller automatic and man-tended space station, named ISF [Industrial Space Facility], whose construction has been turned over to the private sector. This mini space-station will certainly be less expensive, and what is more, could become operational as early as 1992 according to most recent estimates.

11023

Europeans Jockey for Position in ESA Programs

36980299a Stuttgart FLUG REVUE in German May 88 pp 28-29

[Article by Goetz Wange: "Competition for Position After UK Pullout: Dornier Wants Prime Contractor Role for Polar Platform"; first paragraph is FLUG REVUE introduction]

[Text] The originally ambitious polar reconnaissance platform for Columbus, which was to be refueled and serviced in space, risks being cut back to a satellite project. Alternatives are being sought.

With the agreement between NASA and ESA just ready to be signed, serious modifications are already being discussed. Most affected is an aspect only indirectly linked to the space station: the polar platform, a large reconnaissance device intended to scan the earth from a sun-synchronous orbit (altitude, 800 to 850 km) as a complement to its American counterpart. In the preparatory phase British Aerospace was prime contractor for this portion of the Columbus project. With it, the UK planned 14-percent participation in the total European part of the space station. In the wake of the UK pullout, the polar platform must be reconsidered and a new prime contractor sought.

Meanwhile, the Research Ministry in Bonn has recognized that this affects both national and international interests. The first idea of the always frugal administration, i.e., to completely delete the polar platform from the Columbus project, has been rejected. Not merely because of ESA's pledge to the Americans, but also because Dornier, as supplier of the utility module, the drive and service unit of the platform, would have been affected.

The Germans were especially alarmed about the French who immediately began talking about further development based on their SPOT reconnaissance satellites. The most tempting aspect of such a solution would be the cost advantages; particularly since the total calculated amount of DM5 billion for the space segment of Columbus has so far only been 90.5 percent subscribed by the ESA member countries, without even including the polar platform. And it did not help much when Italy and Spain announced their intention to increase their shares, resulting in 95-percent subscription, and British Aerospace—abandoned by its own government—has continued to participate gratis.

Whether the previously exclusively French SPOT will simply become European is problematic. At the very least, the idea of transferring subsystems from other Columbus components wherever possible would have to be scrapped. One example is the resource module of the free-flying MTFF Columbus platform, which has also been used by Dornier System in a stripped-down form in the polar platform.

The Germans want to remain involved in the design of the platform. Because, based on its design, the polar scout will be seen as the precursor of large geostationary information and reconnaissance platforms which can be refueled and serviced in space. Although it currently seems as if these very capabilities might be eliminated because of expense, the opportunity of replacing the British leadership of the project still seems attractive enough to Dornier because of the outlook for the future. In exchange for this role, in Friedrichshafen they would be willing to possibly give up parts of the hardware production.

It is nevertheless already obvious that the European platform will be significantly smaller than the 13 metric tons (3.5-metric-ton payload) originally planned. There is even discussion of a mini-platform of 6 metric tons (1.5-metric-ton payload) using Ariane 4 as a launch vehicle instead of Ariane 5. Only if the financing of Columbus reaches the 100-percent mark, can a halfway ambitious 8- to 9-metric-ton platform (2-metric-ton payload) be built. According to ESA, even that would not be capable of being serviced, but would set the technological course in that direction through inclusion of appropriate design concepts.

The course is set: Basically, the French space agency CNES [National Center for Space Studies]—manager of the entire European shuttle project—has decided to award the first, 3-year systems technology phase for the crew rescue system to MBB [Messerschmidt-Boelkow-Blohm GmbH]. As a formality, the German company will deliver the bid requested by the Hermes prime contractor Aerospatiale at the end of May. Beginning in the fall, 20 to 30 MBB engineers are to work on the design for the ejectable Hermes cockpit.

Total financing of ESA's Hermes program stands at DM9.9 billion. During a first phase, which runs until the end of 1990, DM1.9 billion may be spent for preliminary development. Based on the 27-percent share agreed to in February by the FRG, German participation in this first phase will amount to DM320 million. Approximately one-fourth to one-third of this—according to MBB—is being spent for work on the ejectable Hermes cockpit.

Through the awarding of this developmental contract to the FRG, MBB considers its original request for substantial involvement in the system design of Hermes at least partially fulfilled—even though now neither of the two flight units of the shuttle will be integrated in German hangers. That could not be arranged either in Bonn or with ESA—not in the least because of the associated additional costs.

In the Hermes program, considerable doubt still exists as to whether an ejectable cockpit actually increases the safety of the shuttle crew. "There are still voices taking the opposing view. In any case, absolutely new technical ground is being covered, and that is encouraging. Because, the previous ejectable cockpits in military flight are not comparable to the ambitious objective in the Hermes project. With aircraft, a velocity range of from Mach 0 to 1.8 was considered. Our rescue system must function at Mach 7 at an altitude of 60 km," explains MBB project director Christoph Hohage.

In a second phase in the early 1990's, extensive testing is to be carried out—if the current plan is still being followed. An ejection test using a 1:1 model of the cockpit with a rocket-driven sled ride (Mach 2 to 3) taking the place of the launch with Ariane 5. In cooperation with Dornier, the aerodynamic free-flight phase is to be studied in detail in wind tunnel and computer simulations. The final landing phase with parachute system deployed could then be tested by Dornier in a drop from a test tower.

Which firms will receive contracts in the construction phase of the two Hermes flight units with the components of the rescue system will be decided within the framework of appropriate invitations for bids. Within the German Hermes club, both Dornier and MBB are interested in the cockpit section. The integration of the subsystems is to be done at Ottobrunn in any event.

12666

MBB, PRC Continue Plans for MPC 75 Aircraft

36980284b Frankfurt/Main FRANKFURTER ALLGEMEINE in German 14 May 88 p 15

[Text] Hannover, 13 May—The German-Chinese passenger airplane MPC 75 for short and medium distances that is to be built in the 1990's was introduced to the public for the first time recently at the 17th International Aviation and Astronautics Exhibition in Hannover. In October 1987 the contract was concluded in Peking between Messerschmitt-Boelkow-Blohm (MBB) and the China National Aero-Technology Import and Export Corporation (Catic), and at the beginning of April the two companies had opened an office in preparation for a joint-venture company in Hamburg. The Chinese want to affix their signatures to the agreement in June.

The "M" stands for MBB, "PC" for the People's Republic of China, and "75" for the number of seats in this regional-service aircraft. It is to have a range of 2,500 kilometers, and following the "pre-development phase" it is to be built from 1990 on by the Xi'an Aircraft Corporation and MBB in Hamburg. MBB's head of marketing for transport and commercial aircraft indicates that the volume of capital expenditures will be about $1 billion. The initial flight is scheduled for 1994, and "putting into service" is scheduled for 1996.

The technology of the "aircraft of the 21st Century," according to MBB board chairman Hanns Arnt Vogels, puts all hitherto existing comparable jets in the shade. Thus, a novel cabin information system is planned: At eye level, flat screens built into the backs of the seats are to transmit all relevant communications to the passengers.

The plane will respond to electric signals, it will consume 30 percent less fuel than standard airplanes, and in addition it will be given automatic controls. A central monitoring and maintenance system hooked up to a computer is to permit preventive servicing. The wings will be made of a new type of plastic. The question of the engines is still unresolved: The possibilities are "conservative jet engines," turbo-prop-fan units, or UDF (unducted fan). In order to bring about a solution soon on this, at the aviation exhibition in this Lower Saxony

capital MBB signed with the "Allison Gas Turbine Division" of General Motors a declaration of intent for the overall commercial development of the MPC 75. In any case, Europe's leading aviation and astronautics concern is still looking for partners. It hopes to find these in Japan (Mitsubishi or Kawasaki) or else in the United States (Lockheed), and even in Northern Ireland (Shorts). From the nature of the market, the German aircraft builders in Ottobrunn near Munich and in Hamburg have perceived a demand of 1,000 such airplanes at the end of the 20th century in North America, Europe, and Asia. On the basis of its own data, by the year 2000 the "Middle Kingdom" will need about "300 to 400 such planes in order to be capable of resolving, at least in the air, its transportation problems, which will continue to be pressing in the future as well," according to marketing support manager Guenter Schmid in a talk with this newspaper. But since the Chinese will be suffering for years to come yet with a chronic shortage of foreign exchange, the other MBB partners must at first attend to the financing themselves. Thus marketing chief Peter Thaldorf talks about contacts with 25 different airlines throughout the world. The first MBB engineers have already gone to China.

12114

FRG's Dornier Studies 'Raumkurier' Space Capsule

36980299b Stuttgart FLUG REVUE in German May 88 p 59

[Article by Goetz Wange: "Capsule As Space Courier"; first paragraph is FLUG REVUE introduction]

[Text] Dornier is conducting a study for the BMFT [Federal Ministry for Research and Technology] concerning a recoverable capsule—valuable transportation for materials samples and astronauts.

Worldwide, recoverable capsules are becoming fashionable again in space travel. Even in the Western world where emphasis has been placed for some time on the space shuttle which has proven to be too expensive and, most significantly, only rarely available. In contrast, in the Soviet Union, return technology with capsules has been further perfected both for manned and unmanned use. German users such as the Kayser-Threde company booked flights on several Proton-launched capsule missions through Glawkosmos or—as Intospace did—turned to the Chinese, who were glad to be of service with their FSW and Long March 2 rocket in exchange for currency.

A BMFT-funded study called "Raumkurier" to develop Germany's own capsule has been in progress for almost a year at Dornier. Impetus came not only from the wishes of the Association of Microgravity Researchers but also from discussions of a European capsule capable of bringing back samples from the Columbus station—with correspondingly expensive technology—that could be also used manned as a rescue capsule for space station astronauts. British Aerospace has also recently begun a similar study.

For the present, the German space courier is under consideration primarily for cost-effective return of experiments in the materials sciences. With an overall mass of 1,400 kg, it could carry a payload of approximately 400 kg. With the basic model, a 7-day mission is possible with 200 W of power available to the payload. Longer flights are conceivable with conversion of some of the payload to battery mass. With a diameter of 2 meters, the capsule offers 0.7 cubic meters of space.

Favorably priced launch vehicles currently under discussion are the Chinese CZ-2 and the Soviet Tsiklon rockets. In the design of the space courier capsule, the specifications of newer commercial launch vehicles such as the Industrial Launch Vehicle (ILV) from AMROC have also been taken into account.

12666

UK To Fund Columbus

36980278b Duesseldorf HANDELSBLATT in German 20 Apr 88 p 1

[Text] London, 19 Apr (HANDELSBLATT)—The British government has decided after long hesitation to participate in the European space project Columbus. However, London will not—as first planned—take part in the development of a camera satellite (Radarsat). The UK was to have contributed 100 million pounds to this 350-million-pound project lead by Canada. Of the estimated DM7.7-billion total cost of Columbus, the contribution to a U.S. space station financed by 13 European countries, the British will assume 5.5 percent, or approximately DM420 million. Most of the money is to go toward the development of an earth observation satellite in polar orbit, for which British Aerospace hopes to be project leader. London admittedly expects opposition from the other ESA members because the British were originally to assume a greater share of the expense.

12666

BIOTECHNOLOGY

EC Commission Proposes Biotechnology Regulations

Details of Proposal

3698a230 Brussels EC PRESS RELEASE in English No P-46, 29 Mar 88 pp 1-4

[Article: "A Framework of Law for European Biotechnology"]

[Excerpt] Biotechnology promises to be one of the major industries of the future. It opens up vast new opportunities in major sectors of the economy such as agriculture,

food processing, waste treatment, chemicals and medicine and could grow as much in the coming years as micro-electronics have done in the 1970s and'80s. If Europe's industries are unable to exploit its possibilities, they will seriously damage their ability to compete on world markets. Europe will also lose many of the benefits which genetic engineering has to offer.

It is nonetheless a development of technology which arouses strong public concern and neither industry nor public opinion will have the confidence to allow the creation of a major European biotechnology industry until there is a framework of legislation at the Community level.

The European Commission has now made proposals for the Community legal framework which industry needs and which can ensure technological progress while at the same time ensuring protection of public health and the environment by establishing the general principle of prior notification and endorsement. Public confidence is essential if European industry is to take advantage of the possibilities in this dynamic new field.

The Commission has proposed two directives:

—on the contained use of genetically modified micro-organisms, which would govern the use of biotechnology in the laboratory or as part of a manufacturing process;

—on the deliberate release of genetically modified organisms into the environment, which concerns both experimental releases or the marketing throughout the Community of new products containing or consisting of genetically modified organisms.

A Confusion of National Standards

The need for Community legislation is underlined by the varied way in which Member States have responded to the development of biotechnology. Faced with the need to ensure public confidence while providing a legal framework for industry, some governments have set up formal notification procedures for experimental work in contained conditions, especially to protect people at work. Others have relied on application of existing law governing dangerous substances. Almost all Member States are still undecided as to the ideal framework of regulation.

Deliberate release of genetically modified organisms is generally banned in certain Member States (Germany, Denmark). In one country (Netherlands) regulations are being prepared, others (France, United Kingdom) are relying on case-by-case authorisation. Some (Belgium, Italy) are using existing legislation to cover release into the environment.

Contained Micro-Organisms

The proposed directive differentiates between small-scale processes involving micro-organisms, such as laboratory experiments or pilot applications, and large-scale manufacturing processes. It also draws a distinction between group 1 micro-organisms which are generally safe, and group 2 which have a degree of risk.

For all contained uses of modified micro-organisms, whether they fall within group 1 or 2, the operator must notify the national authorities of his intentions and provide a safety assessment of the project. The competent authorities will verify the information given and the risk classification of the organisms involved. For non-industrial uses of group 1 organisms, the principles of Good Microbiological Practice will be applied to ensure good safety and hygiene conditions. For group 2 organisms, more stringent conditions are imposed. Special measures must be taken for containment such as air filtering, inactivation of waste, and emergency provisions to deal with any accidental escape of micro-organisms.

Contained industrial uses of group 1 micro-organisms are subject to wider controls, exercised by the competent national authorities, requiring provision of detailed information of the process planned, sufficient to allow the authorities to judge the correctness of the classification. With group 2 projects, the operator must provide full details of the micro-organisms involved, the installation, waste management, accident and emergency response plans and a safety assessment. If the plans are not blocked within 60 days, the contained use may go ahead.

Member States shall collect information on any accidents involving group 2 micro-organisms which may affect human health or the environment. This information would also be provided to the Commission which would in turn keep a register of accidents throughout the Community, analysing the causes and recommending ways of avolding similar accidents in future.

Deliberate Release of Organisms

Genetic engineering will sharply increase the number of organisms with new characteristics being introduced into the environment. A system is therefore needed which will protect people and the environment from the possible risks related to the introduction of these new organisms.

Under the Commission proposals, competent authorities in the Member States would be responsible for overseeing projects for deliberate release of organisms for research and development purposes (as against the marketing of new products). However, these authorities would work within the context of Community law. All proposed releases in the research and development phase would be notified to them so they could review the

proposals, endorsing the notification as long as it compiled with the requirements of the directive and provided the risk associated with the release was considered acceptable.

An information exchange system would be established, under which a summary of each notification would be provided to the Commission and to all other Member States, which would be free to request further details and to make comments.

Commission proposals governing the marketing of products involving new organisms do not cover those which are already subject to Community legislation, such as medicinal products, veterinary products, foodstuffs, feedingstuffs and additives, plants and animals or any other products governed by Community legislation which includes a specific risk assessment. The proposals would apply to the marketing of other organisms such as pesticides, herbicides, nitrogen fixing bacteria, organisms for degrading toxic chemicals, recovering oil or treating waste.

The system proposed in analogous to the Community arrangements for the marketing of chemicals. Manufacturers would provide details of new products in confidence to the national competent authorities, together with a risk assessment, details of use and handling conditions and proposals for packaging and labelling. Once the competent authority was satisfied that the product could safely be placed on the market, it would send the dossier to the Commission, which would then forward a summary to all other Member States. They would have an opportunity to ask further information or to request changes in the marketing conditions. A special committee would be set up to deal with any disputes.

This Community process would be subject to strict time limits and to rules of confidentiality. Once a product had been endorsed, it could be marketed throughout the Community, although if evidence subsequently emerged that the product constituted a risk to people or to the environment, it might be provisionally restricted or prohibited by a Member State subject to a Commission decision.

A Rapidly Changing Sector

The Commission has incorporated in its proposals various provisions allowing the legislation to be adapted to changing technologies and scientific knowledge and also to changes on the international level. It is anticipated that the OECD [Organization for Economic Cooperation and Development], for example, will develop new guidelines in this sector, which could be reflected in Community law.

Commenting on the new proposals, Commissioner Stanley Clinton Davis stressed the Commission's two essential aims: to protect people's health and avoid damage to the environment, while at the same time allowing Europe to exploit the enormous benefits of genetic engineering. "If we are to build a major biotechnology industry in the Community, we must retain the confidence of the public. We have proposed a legal framework which will establish effective safeguards for human health and the world around us, without unnecessarily cramping creative innovation in European industry."

EC Views on Biotech Regulation

3698a205 Brussels EC PRESS RELEASE in English No IP(88) 93, 23 Feb 88 pp 1-2

[Article: "Biotechnology Must Be Controlled on a Community Basis"; extracts from the opening address given by Commissioner Stanley Clinton Davis at a business policy seminar on biotechnology on 23 Feb 88, organized by the Study Center for Scientific Policy (CEPS)].

[Text] "Public concern about the potential environmental impacts of genetically modified organisms has been rising steadily for almost a decade. Several member states have responded with voluntary testing and permit schemes, while others have adopted more formal bans on the release of genetically modified organisms to the environment.

Living organisms can reproduce and spread across the earth, ignoring national frontiers in the process. National legislation may help to control domestic releases, but can do nothing to protect one state against the releases of organisms in other states.

Hence, Community legislation is vital for two reasons: the vulnerable growth industries need access to the entire Community market of 320 million people. And only Community legislation can begin to achieve comprehensive protection of the environment. Of course, we do not intend to stop at only the Community level. We will collaborate with other industrial countries within the scope of the OECD as well.

In contrast to the United States, the Community does not have a comprehensive web of product licensing laws that can be applied to cover all potential applications of biotechnology. Because the Community's regulatory slate is comparatively blank in the field of biotechnology we have a unique opportunity to tailor our regulatory requirements closely to the needs of the time—and find a sensible balance between the concerns of industry, government, science and the public.

Only a strong framework of legislation that guarantees the careful assessment of risks before genetically modified organisms are released, the monitoring of uses, and the maintenance of reliable controls can give the necessary reassurance that the authorities are fulfilling their responsibilities.

Our goals in this situation are: —to create a stable regulatory framework that gives the maximum possible assurance that those applications offer no threat to

human health or the environment; —to provide legal sanctions for the enforcement of these regulations throughout the Community; —as a result of these actions, to ensure access for those industries to the entire Community market.

The problem of contained use is in many ways the least difficult. The use of genetically modified microorganisms in contained systems is most unlikely to give rise to types of risks beyond those already encountered in the traditional uses of microorganisms. The levels of physical containment that have been developed over the years should be sufficient to control hazards or potential risks.

The regulatory focus, therefore, both for research and industrial uses must be on ensuring that the risks are identified and that appropriate levels of containment are implemented, on monitoring the use of these microorganisms, on deactivating wastes, on preventing accidents, and providing for rapid emergency response where it may be necessary.

In the case of the release to the environment of genetically modified organisms we are in quite a different situation. We do not yet have much experience in assessing the risks and ecological impacts of new organisms released to the environment.

Given the already high level of public concern about the safety and social impacts of biotechnology, and the reflection of this concern in the highly restrictive policies of Denmark and the Federal Republic of Germany; bearing in mind the lessons taught by, for example, the unforeseen impact of chemical pollution, we must avoid repeating the mistakes of the past and rushing into the technological future without considering its effects on our whole society and on our planet.

If we are to foster public confidence and trust in these industries, we must proceed openly and deliberately. That is why the Commission established the Biotechnology Regulation Interservice Committee in 1985 to draw upon all of the resources of its different services from the very beginning in drafting a regulatory framework and why we published our approach to regulation in 1986.

In the last analysis, we believe that a strong structure combining risk assessment and risk control by industry; government notification, monitoring and enforcement; and transparency of the decision-making process to the public, will provide an essential foundation for the healthy development of these industries, public confidence in their activities, and the quality of the environment in Europe."

COMPUTERS

GMD of FRG Presents IC Simulation System

36980276b Duesseldorf HANDELSBLATT in German 19 Apr 88 p 20

[Text] 18 Apr—The determination of electronic circuits by representing their real behavior on a computer model, the so-called simulation process, is increasingly gaining in importance.

Without this simulation the designing of integrated circuits is no longer conceivable, since the fabrication of prototypes is expensive and time-consuming. Moreover, with integrated circuits it is possible to make inner-circuitry measurements only at the cost of a considerable effort.

But even with circuits having discrete elements, simulation is replacing prototype construction more and more, among other things because a computer model is easier to modify and provides results more speedily. Therefore electrical simulation is becoming more important with non-integrated circuits as well. This is true especially of the kind of simulation of the behavior of a circuit in the time domain that is called "transient analysis." One of the chief obstacles to a broad application of transient analysis is its great demand for computer time, which for medium-sized circuits can amount to several hours even on large computers.

The Association for Mathematics and Data Processing mbH (GMD)—building on work involving the designing of integrated circuits such as has been carried out in the major project "Design of Integrated Circuits (E.I.S.)"—has developed and tested an experimental simulator in its "Sisal" project. Here the goal was to develop and try out new methods for accelerating the running of transient analyses on a computer.

The starting point for this was a procedure developed in recent years that permits a substantially more efficient determination for certain circuit types (especially MOS circuits). Jointly with CADLAB, a cooperative venture between Nixdorf and Paderborn University, this simulator is being refined and converted into a commercial product.

The GMD is showing "Sisal" at the 1988 Hannover Fair for Industry, at the booth shared jointly with the Working Group of Major Research Institutions (AFG).

12114

DEFENSE INDUSTRIES

Management Changes, EFA Decision Affect MBB of FRG

Top Level Changes Imminent

36980230 Duesseldorf WIRTSCHAFTSWOCHE in German 12 Feb 88 pp 100-102

[Article by Peter Pletschacher: "Forced to Do Accounting"]

[Text] The leading German aviation and astronautics concern is again getting into the headlines: CDU chief Strauss evidently wants to force a man of his choosing

into the MBB [Messerschmitt-Boelkow-Blohm] management. Meanwhile, for the Munich people it is imperative to plug up the order gap that is foreseeable for the next few years.

An MBB manager believes himself already able to gauge the consequences if Daimler-Benz AG should become associated with the largest German aviation and astronautics concern: "Then first of all some heads will roll." Yet even in the absence of any public statement at all by the Stuttgart automobile concern with respect to serious intentions about entering into a commitment, in the coming weeks a shake-up in the MBB group's top management is imminent.

Ludwig-Holger Pfahls, at present still state secretary in the Federal Defense Ministry, is to move into the Ottobrunn MBB central office as a new member of the management. At least this is what Franz Josef Strauss wants. Because after the forthcoming retirement of the veteran Sepp Hort, the Bavarian minister president would like to be sure that the interests of the CSU and of the Bavarian Free State will continue to be protected at MBB.

In any case the lawyer Pfahls has had an astonishingly successful career in the CSU. In 1976 he was already employed in the Munich state chancellery, becoming the personal assistant of Strauss and from 1981 on his bureau chief, until in 1985 he then became chief executive of the Federal Office for the Protection of the Constitution as the successor to Heribert Hellenbroich.

MBB is still officially denying that Pfahls will be moving from Bonn into the executive floor of the Ottobrunn aviation and astronautics concern. At present no chair on the managing board is vacant. Hanns Arnt Vogels, chairman of the board, wants to take over some of Sepp Hort's sphere of duties of "outside relations." An insider: "In the last analysis, that is surely also a job for the chief." Moreover, Karl-Friedrich Triebold starts his duties as Vogels' deputy in the next few weeks. He comes from Krupp Atlas Elektronik and will head the division of astronautics.

Since October 1986 a second deputy has been Roland Mecklinger, head of the defense technology division. To be sure, his aim of being heir to Vogels within 4 years at the latest seems to have receded into the distance. Although the harshest adversary of this Vogels deputy, the independently-minded CSU man Sepp Hort, is now on the verge of retirement, nevertheless Mecklinger has not been able to secure a power base for himself. Although the streamlining of the concern's organization conducted by him replaced the old functional structure by a strictly divisional one, all the same he had not made any friends with this reorganization. With Triebold and Pfahls, Mecklinger now has two rivals in the race for the chief's armchair at MBB, because Pfahls also will possibly take on a deputy's function.

But with that the personnel merry-go-round is not likely to have come to a stop yet by any means: The question of whether Daimler-Benz will become associated with the Munich concern continues to be an open one. Federal Economics Minister Martin Bangemann and his state secretary Erich Riedl, together coordinator for the German aviation and astronautics industry, have so far sought in vain to get the Stuttgart people into the MBB cockpit. With that, not the least result should be to neutralize MBB's rival Dornier.

Although Daimler head Edzard Reuter had always signaled his readiness to talk, still he has made it clear again and again that in no way is he prepared to take over the Airbus risks. These must be borne by the Federal Government itself, he said. Meanwhile new rumors continue to circulate about how and when Daimler-Benz will join the Munich aviation concern.

Meanwhile MBB chief Vogels is also speaking out in favor of a close cooperation, perhaps even a merger, between MBB and Daimler's subsidiary Dornier. Vogels said in the most recent issue of the employees' magazine of his firm: We can no longer afford the luxury "in our small republic" of having several businesses be mutually competitive in connection with various aviation and aerospace programs.

For Mecklinger, the public discussion about the future of MBB is "in no way useful." In fact, this firm has been taken to markets by the politicians in an almost embarrassing fashion in recent years. Their desired candidates such as BMW, Mannesmann, and Siemens all declined. Mecklinger stresses emphatically: "After all, we are not a case for rehabilitation."

In fact a pickup in the business situation is emerging. Although in 1986 a severe loss of DM 104 million had to be absorbed for the first time and initially a similar deficit for 1987 was feared, now the management has given the all-clear signal. Sales during last year are likely to have again risen markedly above the limit of DM 6 billion, and a small profit in the single-digit millions can even be anticipated. And this despite the fact that as in past years MBB had to transfer a sum of DM 150 million to its 100-percent subsidiary Deutsche Airbus GmbH as a liquidity stimulus. "We have already put a total of DM 2 billion of our own funds into the Airbus program so far," Mecklinger figures. And thus the burden that the concern will still have to bear for the foreseeable future becomes clear: "The Airbus issue cannot be resolved by any industrial outfit," according to Mecklinger.

In any case, MBB chief Vogels has already passed the watchword on a possible takeover: "The alternative bears the name MBB." And he wants also to convey this newly discovered self-confidence to his employees. At the beginning of the year he had it proclaimed: "MBB is better than its reputation." But problems are being caused, and the MBB chief is also trying to make this clear to his people, by the effort "to shift the MBB

mentality over to a fixed-price way of thinking." He continues: "Until recently it still seemed almost inconceivable at MBB to change to a calculation of prices that is common to industry and to make the urgently needed cost adjustments."

The aviation and astronautics concern will have to begin to put this new way of thinking to the test quite soon. For the planned German-French attack helicopter PAH-2 the Federal Defense Ministry has already negotiated a fixed-price contract with MBB: Every cost overrun must be justified by the company and it must bear half of this itself.

Moreover, MBB is fighting for a major program that will be of decisive importance to employment in the 1990's. It pertains to the European fighter aircraft of the 1990's, and MBB has a third share in this project in addition to companies in Great Britain, Italy, and Spain. Although the Luftwaffe is urgently in need of a modern replacement for the outdated Phantom combat airplanes, the dictate of empty coffers is forcing it to take radical economy measures. Industry has been waiting years already for the starting shot for the development phase. But the Federal Government does not want to accept the DM 6.7 billion assessed for the German share. For the production of 250 successors to the Phantom, the Jaeger ["Fighter"] 90, an additional roughly DM 20 billion would have to be appropriated for the period beyond the year 2000.

Carl Peter Fichtmueller, the man in the MBB management in charge of the division of helicopters and aircraft, certainly sees possibilities for covering the costs for the development of the Jaeger 90: "We are prepared to increase our risk. But in order to economize, cutbacks in the technology should also be made. Furthermore we are studying the proper correlation of costs." It is not at all disputed at MBB that this might simply mean to shift costs from the development phase into later phases of the program. In any case, he said, it is now imperative to carry on resolutely with the Jaeger 90 if the future of the European aviation industry is to be ensured.

In fact the Americans have already undertaken a massive effort to thwart this project. McDonnell Douglas is offering the German pentagon an improved version of the F-18, which meets 90 percent of the technical requirements but is supposed to generate only 30 percent of the costs of the Jaeger 90. In Bonn the story is even being spread that the Americans would behave themselves on the question of competition in the Airbus business if the idea of a European combat aircraft development were abandoned.

However, MBB does not want to let it come to that: "Whoever does not want a Jaeger 90 must know that he is uncoupling himself from the alliance of the European partnership," warned Vogels. He said that without the Jaeger 90 the future of the Airbus program is also endangered, because the technologies developed by the military sector would benefit civilian aircraft construction. Vogels even threatens openly: "Whoever does not want the Jaeger 90 also does not need any manned space-travel program."

In any case, for MBB the Jaeger 90 has become the heart and crux of the issue of the full use of its capacities in the next decade, because Tornado production is coming to an end in a few years. But the new helicopter programs PAH-2 and the NATO helicopter NH-90 will sustain production to a marked degree only from the middle of the 1990's on. "We must anticipate a dip in employment," admits Fichtmueller.

Table: Going Downhill—Key Business Figures for Messerschmitt-Boelkow-Blohm GmbH from 1981 to 1987

	1981	1982	1983	1984	1985	1986	1987*
Sales (in billions of marks)	4.850	5.678	5.875	5.719	6.001	5.635	6.2
Order inflows (in billions of marks)	4.721	5.238	6.370	4.620	6.519	6.454	—
Capital expenditures (in millions of marks)	371	315	303	273	320	448	—
Employees	39,623	38,494	36,790	35,485	36,915	37,642	37,000
Year's net earnings/loss (in millions of marks)	58	60	92	98	109	-104	0

*Estimated

Interviews With Division Chiefs

36980230 Stuttgart FLUG REVUE in German Mar 88 pp 21-24

[Interviews by FLUG REVUE staff with Dr of Engineering Roland Mecklinger, MBB vice chairman; Dr Carl Peter Fichtmueller, head of the helicopter and aircraft division; Hartmut Mehdorn, head of the transport and commercial aircraft division; and Dr Hans Kappler, head of the division for orbital systems and launch vehicles]

[Text]

Technology Holds Chances for Growth

FLUG REVUE: You are regarded as the heir apparent within the MBB management. In 1991, when the change in the leadership comes up, will there still be an independent MBB company?

Roland Mecklinger: You will have to ask our stockholders that.

FLUG REVUE: For national aviation industries it will become increasingly difficult to carry out major projects

in the future. Do you see possibilities for realizing such projects within an international cooperative effort while keeping to your own ideas and maintaining your own operations in Germany?

Roland Mecklinger: I think that the ability to cooperate and the necessity for cooperation is the key. The FRG in particular will never again be able to implement or carry out such gigantic programs on a national level alone. Just because of the size of the German market it is nonsense to attempt this merely from the point of view of the financial expenditure. Therefore international cooperation is an absolutely essential element, but what is important here is to look for and find a partner in cooperation that provides the best help in view of the particular project and perhaps even the particular product. A cooperative effort does not need to be only a German-American or German-French one, but must be determined on a case-by-case basis. In any event, bilateral or multilateral programs are preferable to purely national programs. France perhaps has a certain special role to play. For France the nationalistic aspect of "la grande nation" is always a key factor. But we at MBB have had 25 years of experience with France by now, with quite outstanding success. Finally, what is relevant here is not only the will but also the knowledge of how this is done. But in this respect also one should not commit himself only to one party, but must be capable of cooperation with any party, depending on the technology. That leads to competitive strength, because the market for all these products is the international market and not only the national markets.

FLUG REVUE: But then must not pioneering work on the national level, a certain technical ability, be shown in order to be accepted as a partner?

Roland Mecklinger: Of course. No country or business would want to cooperate with MBB only because it bears the three letters MBB. But we are a very sought-after cooperation partner precisely because we have a very broad technological basis that we have acquired with great effort over a period of many years.

FLUG REVUE: Then could it be imagined that a stronger industrial interlinking with foreign partners—a number of major programs might present themselves as seed crystals for this—can be realized some day?

Roland Mecklinger: We have that already. We have established international cooperation arrangements and firms with a great number of foreign companies. This is being done with the United States, with France, and incidentally also—and this is having more and more of an effect in Europe—with Italy. Italy is becoming an increasingly strong and increasingly attractive partner.

FLUG REVUE: In the long run do you see at all any possibility still that the private sector might carry out projects such as the hypersonic aircraft MPC-75 or the data-relay satellite?

Roland Mecklinger: I am reluctant to say: Private sector production means cheaper production. The oligopoly situation in which we find ourselves means that we must offer our products, our ideas, our systems in a really tough competitive situation. It is only on the basis of tight structures and forms of organization that you can make certain that in the future you can be still active at all in this market. Each day one must fight for this anew.

FLUG REVUE: Will MBB or other companies be able at all to finance projects such as the hypersonic aircraft if a public contracting authority is not also present?

Roland Mecklinger: Naturally for such projects only the state can be the contracting authority. It is only necessary to take care that the states do not produce a wild and chaotic competition with one another. In the case of the hypersonic airplanes there are already three or four concepts in the Western hemisphere alone. Accordingly the first thing one must discuss very intensively is an idea-competition among the governments concerned as possible contracting authorities. Here industry cannot manage alone.

FLUG REVUE: Then in the future as well industry will not be able to make do without a governmental contract in connection with major projects?

Roland Mecklinger: Such technologies can be developed only under contract with the state.

FLUG REVUE: Do you see in the attitude of the German public toward technology, concerning the frequently expressed criticism that this industry is a bottomless pit, perhaps also a reason for the difficulties that you are having with individual programs?

Roland Mecklinger: Yes. If Germany is compared to France here, it will be found that such a discussion would not be possible at all in France. The ordinary French citizen has a quite different understanding of technology. It is viewed as a motivating force, as a chance for growth. In Germany, the word "technology" is immediately associated with concepts such as subsidies, the state, and "bottomless pit." That is a pity. For me, the technology about which we are speaking here is particularly important, because it harbors chances for growth in the future. One should never try to justify anything with the argument about "jobs." If the orders are not there, these technology fields are irretrievably lost and can no longer be established.

Military Aircraft, Helicopters—"Industry Is Prepared to Bear an Increased Risk"

FLUG REVUE: The Federal Ministry of Defense is demanding considerable cost reductions for the Jaeger 90 (EFA). How are these to be realized?

Carl Peter Fichtmueller: The JF90/EFA program is of the utmost importance to MBB. Accordingly we will do everything we can to meet the stipulated basic financial conditions. We have constructively considered the suggestions that the presently projected development costs are too high. The industry is prepared to bear an increased risk within the framework of the upper price limits and thus to meet the budget of the contracting-authority side to a certain extent. But certainly this cannot solve the whole problem. Moreover in the discussion between the official side and industry thought is being given, among other things, to making certain cutbacks in marginal areas of the EFA program contributions and to undertaking certain changes in the management. The dialogue on this is still going on, but we are confident that it will be possible to reach the goal for the development budget. By the way, the taxpayer should know that it is not the case that upper price limits are set only by the industry, but rather that the responsibility for these is borne also by the contracting authority after comprehensive consultation.

FLUG REVUE: The EAP test vehicle is flying in Great Britain. What effects will emerge from that for the EFA? Does German industry have to fear disadvantages because it had to drop out of this program years ago?

Carl Peter Fichtmueller: For one thing the EAP has confirmed the correctness of the EFA basic design. It is also entirely conceivable that this testing stage, representative of the EFA in many areas, will be used for studying individual features of the different systems.

FLUG REVUE: What disadvantages would result from stopping the EFA program and the production under license of an American prototype?

Carl Peter Fichtmueller: Regressing to the phase of licensed production would signify the end of an independent combat-aircraft construction in Germany. Moreover, European cooperation in this sector would also be seriously jeopardized. It is not conceivable to skip over a generation of aircraft and then again become involved in the construction of combat aircraft. Accordingly a stopping of the EFA would signify a negative change in direction, probably for all time to come.

Helicopters

FLUG REVUE: The slackness in the civilian helicopter market continues. Can MBB tolerate being in the red in this business area for very long?

Carl Peter Fichtmueller: We expect that within the next few years the international helicopter market will again pick up. Regardless of whether this happens, we have initiated a program to adapt ourselves to the market and to the competitive conditions. We are assuming that in the future as well we will be building civilian helicopters.

FLUG REVUE: In Europe there is an excess capacity in the helicopter sector due to numerous suppliers. Is there not a necessity for closer cooperation?

Carl Peter Fichtmueller: Assuming a revival of the international market and a conceivable substantial need by the Bundeswehr in the 1990's, MBB views helicopter construction as a growth sector for itself. From the military programs such as PAH-2 and NH90 there are emerging foundations for cooperation on the European level, which certainly could also develop beyond these programs into a more comprehensive cooperative effort.

FLUG REVUE: Will the prop rotor (Eurofar) be creating new markets in the near future?

Carl Peter Fichtmueller: The fact that Eurofar is being developed shows that European industry is assuming there will be opportunities on the market for this technology. An attractive area of application would possibly be a regional air service.

Commercial Aircraft—"Lower the Cost of Products by Taking Advantage of Inexpensive Markets"

FLUG REVUE: It is being said that costs should be lowered further for the Airbus. Do you still see possibilities for doing this?

Hartmut Mehdorn: The devaluation of the dollar by about 25 percent and the statements that have been made about this have created the impression among the public that we must keep pace with the dollar in terms of productivity—that is, we ought to further reduce our costs by 25 to 30 percent. It is not possible to do things this way. Salary and material costs represent only about 25 percent of the total aircraft price. Naturally with this 25 percent one cannot save 30 percent of the total costs. So we also have to examine the superposed costs. Here I still see possibilities in both the national and the international sectors.

FLUG REVUE: There has been much discussion about a cooperative effort between the European Airbus builders and McDonnell Douglas. In such a case, will enough work still remain for your division?

Hartmut Mehdorn: As a rule more than 50 percent of the American aircraft models are produced outside the United States. In the case of McDonnell Douglas, actually less than 20 percent is produced by the firm itself: The firm restricts itself to final assembly, system management, and high-technology structural components. In Europe we produce more in our own firms, but we have not yet taken the step of making our products cheaper taking advantage of attractively-priced markets. But in the near future we will be achieving production rates of more than 10 airplanes per month with the A300, A310, and A320, and later with the A330/340. Here the American market recommends itself to us, especially since—given the very favorable dollar situation at present—we

can cheaply buy product outputs in the United States, by means of which we neutralize our dollar risk. For our factories this means that we should build up our own capacities only to a limited extent.

Astronautics—"Shuttle Problems Have Cost Us Much Money"

FLUG REVUE: Was it a mistake to concentrate on system management in the Columbus Program and let the Italians and British go in front where those components of the space station with publicity appeal can be brought into the picture?

Hans Kappler: It is a widespread misconception among the public that technology manifests itself only in displayable hardware. To design a complex overall operational system is technology of the highest rank. In the case of the Airbus, on the other hand the complaint is that German industry, as a mere subcontractor, is losing the ability to build complete aircraft. We are placing our hopes on the proper mixture of system-management ability and hardware production, for example in the case of Ariane.

FLUG REVUE: The change in concept with Ariane 5—elimination of the cryogenic upper stage—and the abandonment of the drive module for Hermes have affected MBB especially. How can this be made up for?

Hans Kappler: In the development phase we are not dissatisfied with the Ariane upper stage L-5 and the ejectable crew's cabin of Hermes. It is otherwise with our share of the production, where more would have been possible if there had been a more timely and aggressive policy with respect to participation on the part of the Federal Government.

FLUG REVUE: In what shape are sales expectations with commercial users, above all in the area of microgravity experiments?

Hans Kappler: Although we know that the market potential is there, we must not count on large volumes of business after only a few years. Because of the loss of the shuttle fleet there were unexpected revenue problems for us in the programs that lead up to commercial utilization

Layoffs Predicted if EFA Canceled

36980230 Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG in German 12 Mar 88 p 12

[Text] Munich, 11 Mar—The largest German aviation and astronautics concern, Messerschmitt-Boelkow-Blohm (MBB) in Ottobrunn near Munich, does not as yet see any reason for being pessimistic about the chances that the combat aircraft "Jaeger 90" will be built, despite a number of unenthusiastic statements made in the budgetary committee of the German Bundestag (FRANKFURTER ALLGEMEINE ZEITUNG of 9 March). It says that this project is needed as a follow-on to the Tornado program, which is to expire in the 1990's. The major projects of European aviation and astronautics belong together, since there are close interrelations and technical exchanges among them, according to MBB.

Of the DM 16.5 billion earmarked in the Bundeswehr's plan for constructing 200 airplanes of the Jaeger 90 type the FRG and England will each receive 33 percent, with the general contractors being MBB and British Aerospace, 21 percent will go to Italy with Aeritalia as contractor, and 13 percent will go to Spain via Casa. The general contractors will be placing special orders with other firms.

MBB chief Hanns Arnt Vogels has repeatedly pointed out that the design engineers for the Jaeger 90 and for the European aircraft Airbus have been exchanging ideas and innovations back and forth. He said that for the Airbus MBB needs an extra 2,000 technical specialists, and in addition another 2,000 would be needed in the equipment industry that would start producing for the Jaeger 90, as well as 1,000 engineers who would develop the propulsion unit for the Jaeger 90. According to MBB, without the Jaeger 90 this number of design engineers cannot be kept employed. Without it the Airbus program would also become more expensive. According to Vogels, anyone who does not want a European-developed Jaeger 90 must understand that he will be losing some competence and competitiveness in defense-related and futuristic technology. New aspirants, from Japan to South Korea, Taiwan, and Singapore, are waiting in the wings, he said.

The recently expressed proposals on replacing the Jaeger 90 with the American "F-18" as the basis for a modern fighter aircraft "Hornet 2000" is rejected as an alternative at MBB. To be sure, this firm would also participate in this as a licensee. But MBB argues that reequipping the F-18 in order to upgrade its combat effectiveness would be more expensive than a new aircraft development. Moreover any such plane should be capable of still being adaptable to modern requirements even in the year 2020, which is doubtful for an airplane coming from the 1960's. It says that furthermore an improvement in the state's coffers is more certain in the case of domestic production, because the return flow of funds via various taxes can then reach 49 to 59 percent, whereas with production abroad it would be only 12 percent.

12114

EFA To Incorporate Advanced Technologies

Delta/Canard, New Engine

36980284a Stuttgart FLUG REVUE in German Apr 88 pp 13-14

[Article by Hans Redemann: "Technology for EFA: Delta/Canard Design, Modern Materials, New Engines"]

[Excerpt] The JF-90/EFA is a low-wing aircraft in a delta/canard design with a nose sweepback angle of 53 degrees. It will be classified within the weight class whose

maximum is 17 tons, and it has an aerodynamic wing area of 50 m^2. Officially not much is known about the outside dimensions, but the wing span is supposed to be about 10.50 m and the total length is said to be around 14.50 m.

To an extent previously unheard-of, exotic materials are being used in the construction of the airframe. Only 15 percent of these materials will consist of various conventional light-metal alloys. The remainder is divided between carbon-fiber and titanium materials. For certain structural parts the designers have also relied on ultralight lithium alloys. This applies above all to the fuselage frames in the region of the wing attachments to the fuselage. In order to be able to optimally dissipate their bending moments in the fuselage, the separate mountings are made of titanium.

At first the mid-plane sections of the fuselage will still be milled in the integral-construction process, but later forged blanks are anticipated for this. In this way the machined portion can be kept as small as possible. The wing assembly has a multi-spar structure with a carbon-fiber skin, which is also the case for the large tail fin. The requisite structure technologies are now being developed in the advance work for the JF-90 program. This also pertains to the superplastic forming (SPF) of light-metal and titanium sheets and to new cementing methods.

In accordance with its primary operational task as an interceptor aircraft, the JF-90 will be armed with a rigidly mounted 27-mm rapid-fire gun of the type IWKA-Mauser Bk. 27, which is also suited to firing at ground targets. It has an electronically controllable rate of fire of up to 2,000 rounds/min. At its fuselage and wing sites the JF-90 will be able to carry up to eight air-to-air missiles of the new types AMRAAM and ASRAAM for intermediate and short ranges respectively. Its theoretical maximum speed with a full load is about Mach 1.8 at an altitude of 11,000 m. Even near the ground it still reaches a speed of more than Mach 1.

As their choice of engine for the JF-90, the four countries involved in the program decided on the new EJ200. But for a long time the F404 of General Electric was also a serious candidate, and the German Federal Ministry of Defense in particular had its eye on this. For the eight prototype planes the version Mark 104D of the Tornado engine RB199 will probably be installed, because at the beginning of flight testing the EJ200 will not yet be available. The EJ200 is a twin-shaft turbofan, which with afterburning delivers a thrust of 90 kN. Its thrust/weight ratio is about 10:1 and the total compression ratio is over 25:1.

Engine EJ200 Is Being Built Specifically for the EFA

It will be outfitted with modern technology products such as monocrystal turbine blades and fully digital control. Furthermore it will have a convergent-divergent propelling nozzle, in order to achieve better operational performances at a high Mach number. No thrust reversal is being planned. Even during the development of the EJ200 special attention is being directed toward certain factors. These include above all great reliability, long lifetimes for the components, and also simplicity in maintainability. These have a priority equally high as those of performance and weight. The Eurojet Engines GmbH with headquarters in Munich, in which Rolls Royce, MTU, Fiat, and Sener are involved, is taking responsibility for the overall development of the engine.

The fuel system of the JF-90 consists of integral tanks in the middle portion of the fuselage. But in order to increase the range, at the wing sites jettisonable additional tanks can also be carried along. Moreover the plane can be refuelled in flight as well. The requisite boom can be swung out from its position on the right side of the forward part of the fuselage, beneath the cockpit.

Air as the working medium is fed via two air ducts to the two engines mounted side-by-side in the back part of the fuselage. The air intake beneath the middle part of the fuselage is already regarded as a characteristic outward feature of the JF-90. Following wind tunnel tests this was modified several times, and because of its raised outer sections it is now also called the "keep smiling intake."

Thanks to this engine system and the aerodynamic design of the delta-wing assembly coupled with canards, the JF-90—which is equipped with a fly-by-wire control system—has an outstanding maneuverability. The runway requirements are small: A takeoff distance less than 600 meters is sufficient, and to shorten the landing distances the airplane is equipped with an air deflector directly behind the cockpit, which swings forward into the air stream.

All in all, it appears that the design of the European fighter aircraft of the 1990's is already nearly perfected. Although this speaks well for the new aircraft, certainly there is still much to be done before the completion of the first prototype. But the prerequisites for this are decidedly favorable, and one can only hope that the Luftwaffe will not be the only air force for which the JF-90 can commence its active field service from the mid-1990's on.

Radar

36980284a Stuttgart FLUG REVUE in German Apr 88 p 14

[Article by Helga L. Hillebrand: "Second Start—EFA Radar: New Bids Handed in"]

[Text] Early in February the competing consortia handed in their bids in response to the modified call for tenders on the EFA radar system. In the running are the Ferranti group with its ECR90 and the AEG team with an improved APG-65.

The competitive battle over the contract for the radar of the future European fighter aircraft EFA with look-down-shoot-down capability has entered into its second phase. The initial bids of the two consortia in this competition had been received back in March 1987, and a decision was supposed to have been made long ago. But because of delays the call was made for the resubmission of bids by the consortium under the leadership of the AEG, whose radar proposal is based on the American APG-65 of Hughes, and by that of Ferranti, which with the ECR90 is building on its own development, the Blue Vixen. This time limit passed on 8 February 1988. And the two are still in the running.

Initially there were certain doubts about whether it would be advisable to integrate American technology into a purely European fighter aircraft. After all, the European allies had already had unfortunate experiences with earlier cooperation programs, in which a cooperative effort mostly turned into a production under license, because the American Department of Defense prevented the technology exporting of militarily relevant products out of fear that these might be passed on to countries of the East Bloc. But these fears now seem to be groundless. Christian M. Shore, regional director for international products with Hughes in Los Angeles, gave assurances that according to information from the Pentagon no export limitations or restricted technology transfer need to be anticipated. Also Walter W. Bender, marketing manager for the EFA program at the Hughes Radar Systems Group, expected the definitive clearance to be given as early as in February.

This optimism is not unfounded. Back in January the American company Texas Instruments, which wants to build with Thomson-CSF a new radar for the French Rafale, had received the consent of the American military.

This may accelerate the negotiations with the Pentagon. On the other hand, with that a new rival could also emerge in the EFA competition. The requirements for the Rafale radar and that of the EFA are not so far apart. It is true that at present Walter W. Bender (Hughes) does not yet see any danger here, because given the present timetable for the EFA this new entry would probably come in somewhat too late. But if there are further delays this situation could easily change. And a spokesman for Thomson-CSF did not want to entirely rule out this possibility even in 1987, at the Aerosalon in Le Bourget.

Meanwhile Hughes and AEG are trying out their partnership in connection with the licensed production of the APG-65 as a part of the combat effectiveness upgrading program for the F-4F Phantom II of the German Air Force. The initial radar units for installation in the Phantoms were just recently delivered to Messerschmitt-Boelkow-Blohm (MBB) as the chief contractor. Within this program the AEG will familiarize itself with the manufacturing of the APG-65, a move which is then likely to pay off in case of an appropriate decision on the EFA.

Therefore Hughes is also hastening to stress that despite its American-radar foundation, the EFA radar offered will be a European system. AEG as the consortium leader will redesign the antenna. It is to reflect the most modern technology and is to be a so-called active phased array antenna. In this new technology, each antenna cell is separately driven. Then the antenna itself no longer needs to be swiveled to detect the targets. Also the antenna diameter is being enlarged compared to the standard APG-65 antenna, from 66 to 75 centimeters.

The English partner Marconi (formerly GEC) is developing a new, more powerful signal processor, the Spanish company Inisel is to make revisions in the data processor, and the Italian FIAR will construct a larger, more powerful transmitter. Only the receiver remains unchanged. The extent of participation by Hughes is limited to the supplying of certain components and to technical advice.

12114

ENERGY

ECC Proposal for Exploitation of Renewable Energy Sources

3698m368 Bonn TECHNOLOGIE NACHRICHTEN-PROGRAMM INFORMATIONEN in German No 422, 20 Apr 88 pp 2-11

[EC Commission Report: "The Exploitation of Renewable Energy Sources in the European Community; Proposal of the EC Commission for a Recommendation by the Council to the Member States"]

[Excerpts] **Summary** [not translated]

I. Introduction—Purpose of the Proposal
II. Present situation, obstacles, economic aspects, and other factors in connection with the further development of renewable energy sources
III. Analysis by sectors
    1. Solar Energy - Thermal Exploitation
    2. Solar Energy - Photovoltaics
    3. Use of Energy from Biomass and Wastes
    4. Geothermal Energy
    5. Wind Energy
    6. Water Power
IV. Concluding Remarks
V. Proposal for a Recommendation by the Council to the Member States on the Development of the Exploitation of Renewable Energy Sources in the Community

I. Introduction - Purpose of the Proposal

With its adoption in November 1986 of the resolution on directing the Community toward the further development of new and renewable energy sources (Official Gazette C 316 of 1 December 1986), the Council underscored the necessity for further developing the exploitation of these energy sources in the Community in an appropriate fashion.

In particular the Council defined the objectives to be pursued within the framework of such a Community orientation, which are above all:

—1. Optimizing the exploitation of renewable energy sources in the Community while taking into account their economic viability and their availability in each member state;

—2. Optimal utilization of the efforts to further develop the exploitation of these sources, in connection with which duplication of work must be avoided and an extensive dissemination of the results everywhere in the Community must be ensured;

—3. Guaranteeing concerted action at the Community level for the sake of the coherence of the national projects for the further development of these sources;

—4. Elaborating actions at the Community level for promoting the use of these sources;

—5. Facilitating industrial cooperation in various sectors of renewable energy sources, and expanding the markets within the Community.

The present proposal is to be an initial recommendation with respect to achieving the objectives specified in the above-mentioned resolution. This recommendation applies to all renewable energy sources. Furthermore the Commission is continuing the work designated in the plan for the orientation of the Community toward the further development of new and renewable energy sources (Doc. KOM(86) 12 of 23 January 1986; as part of the work planned in the above-mentioned orientation the Commission has proposed the inclusion of a new budget entry "support for activities in the area of renewable energies" in the 1988 budget. Since 1988 is the first year, funds have been asked above all for supportive activities, for example exchange and dissemination of information, preparation of studies, singling out of advisors), and it intends to submit to the Council sector-related proposals on each of the energy sources.

The present proposal concerns itself with those renewable energies that, given the present state of technological developments, have definite prospects of being successful in the energy market. This pertains to the following energies:

—Solar energy, thermal exploitation and photovoltaics;
—Use of energy from biomass and wastes;
—Geothermal energy;
—Wind energy;
—Water power, especially low-output water power.

II. Present Situation, Obstacles, Economic Aspects, and Other Factors in Connection With the Further Development of Renewable Energy Sources

In order to assess the present situation in the Community in the sector of the further development of the use of renewable energy sources and in accordance with the obligation entered into at the "Energy" conference of the Council of 26 November 1986, in March 1987 the Commission called a meeting of the member states' scientific and technical advisors on renewable energy sources. This meeting made it possible for the Commission to obtain information about the priorities in the separate member states, the present state of the technology, prospects, potential, obstacles, and current programs. This information is the subject of a detailed report.

The most important aspects of the present situation and of the prospects in the separate member states can be summarized as follows:

- In all member states there are more or less extensive projects in support of the further development of renewable energy sources (with the exception of Luxembourg, which because of its special situation is directing its efforts toward energy conservation). There are various types of obstacles that stand in the way of this development. There are technical or economic but also frequently legal or institutional obstacles. Above all because of varying geographic conditions, in the separate member states differing priorities are set especially as concerns solar energy, wind energy, geothermal energy, and water power, whereas the further development of the exploitation of the energy from biomass and wastes is meeting with general interest.
- By the year 2000 the contribution of renewable energy sources to the energy supply of the member states is likely to be relatively modest still (2 to 6 percent, depending on the member state). But in the longer run the prospects could be more favorable, depending on the development of prices for conventional energies and on the efforts that are made to achieve the technical competence needed to handle the renewable energies. In this connection it must be pointed out that the Council in its resolution of 16 September 1986 on new energy-policy objectives of the Community for 1995 and on the convergence of the policies of the member states (Official Gazette No C 241 of 25 September 1986) expressly stresses that "the part played by new and renewable energy sources in the replacement of traditional fuels should be considerably increased so that these energy sources can make an important contribution to the overall energy balance."

Furthermore the Commission, in its communication to the Council on new objectives for 1995 (Doc. KOM(85) 245 of 22 May 1985), gave as a quantitative objective a tripling of the energy contribution from renewable energy sources, and it defines this objective more sharply in its communication to the Council (Doc. KOM(86) 12 f of 23 January 1986) on the orientation of the Community toward the further development of these sources. According to this, in the year 2000 such sources could make up about 5 percent of the energy requirements of the Community (inclusive of high-output water power, but excluding firewood).

- As far as economy and competitiveness are concerned, the conditions for the development of renewable energy sources have worsened in recent years because of a relatively good supply of conventional energies and owing to the development of their prices. This is true above all of thermal utilization, whereas in certain cases the generation of electric power remains competitive, especially in isolated regions.

III. Analysis by Sectors

In this section of the report the main features of the renewable energy sources dealt with are described; for each one its potential, the technologies needed for its exploitation, its market position, economic aspects, and problems involved in its development are presented.

But certain problems arise in connection with the further development of all renewable energy sources.

The lack of specific legal regulations and suitable administrative procedures for these energies frequently represents one of the main obstacles to their use. In most cases, this results in difficulties and extremely long waiting periods before exploitation is approved, and these things can discourage the execution of the projects. Only on the basis of specific regulations that also take into account environmental aspects can such procedures be made clear and be accelerated by means of simple and speedy decision-making processes. Such regulations are not yet in existence in several member states.

The use of renewable energy sources presupposes that these are known about and understood. But the understanding of these resources within the Community is not satisfactory. The studies on energy potential and on specific possible applications must be improved so as to be able to better assess the possibilities of renewable energy sources, especially on a local and regional level.

Generally these forms of energy require significant capital expenditures, with this necessity being frequently due to the fact that it is not yet possible to count on quantity-governed cost-lowering effects resulting from a larger market. The financial burden may prove to be too large above all for regional and local authorities and small or medium-sized businesses; moreover the capital expenditures in question are in part those entailing a certain technological risk. To facilitate decisions on making capital expenditures for the exploitation of renewable energy sources, appropriate and flexible financing options are needed. Aside from this, frequently even the feasibility study and the technical preparation at the beginning of the project are already too expensive. A system of financial aid at this stage would probably facilitate a decision on the execution of such a project.

Another problem for all these energies arises with respect to free trade in the industrial equipment used for the exploitation of renewable energy sources in the Community. Significant efforts ought to be made to achieve common licensing criteria and thus a larger and more rationally functioning market.

In addition the economic situation of projects for power generation from renewable energy sources is governed by the contractual relations with the public electric-power generators or suppliers into whose power networks flows a portion or all of the electricity generated. These contractual relations must be stable and balanced and, as much as possible, offer economically acceptable prospects for the future.

Finally, the share held by renewable energy sources in the energy balances is not being properly reported, since there is not yet an appropriate statistical data-collection system. The available information is deficient and incomplete because of the geographical variability, the complexity of the subject, and the various authorities involved. The methodological problems entailed in including renewable energy sources in an energy balance system should be examined closely, so that satisfactory statistical methods can be found.

Solar Energy—Thermal Exploitation

There are a number of estimates on the possible contribution of solar energy to meeting the energy needs of the Community. On the basis of technological developments foreseeable in the short run, this contribution will range between 0.5 and 1 percent of the Community's consumption in the year 2000 (6-12 million tons of ROeE [crude oil units]).

The market for solar energy consists of two sectors: Low or intermediate temperature applications (up to 100 degrees C), and high-temperature applications. In the first sector (passive utilization, generating hot water, and space heating by warm air or warm water) the market is larger. The applications at high temperatures serve to make available industrial process heat and also are for steam and electricity generation. This technology presupposes the use of concentrating collectors with working media that are operational at temperatures above 250 degrees C. These systems have not yet achieved a breakthrough on the market because of their complexity, high costs, and doubts about their reliability.

Numerous applications in the low-temperature range are already cost-effective at the present time. The technologies used in swimming pools have come of age, and the market is growing steadily here. Furthermore the existing buildings in which the principles of the passive use of solar energy are being applied show that for both old and new structures a market already exists. Demand in this potential market could be encouraged by an appropriate policy. However, the active exploitation of solar energy for space heating is succeeding only in part. Warm-air systems can be already offered at competitive prices. In contrast, solar collectors with liquid heat carriers are not very economical so far. In connection with generating hot process water the technology used is now already economical in southern Europe, and the most recent advances in designing and in reducing manufacturing costs will increase the application possibilities of this technology in certain regions of northern Europe as well. The markets for similar systems for hot-water generation in industry have not come of age so far. In agriculture, there are greater application possibilities for solar energy. Here, successful demonstration projects have established a considerable potential for its use in drying facilities, for frost protection in greenhouses, and in natural ventilation systems.

Aside from the problems common to all renewable energy sources the thermal exploitation of solar energy is hampered above all by the facts that in general neither the architects nor the potential users are aware of the possibilities of solar systems, that the installers are not always appropriately trained, and that standardized material is not always used, which makes installation more difficult.

In addition even the public authorities do not always include solar energy in their plans for their own buildings, and the building contractors or the banks that provide the financing are likewise not looking into the possibility of using solar energy.

Solar Energy - Photovoltaics

The contribution of photovoltaic energy to the energy balance of the Community will be minimal by the year 2000; but there are other important arguments in support of the use of this technology, for example the improvement of the infrastructure and of living conditions in disadvantaged regions, since such improvements have a beneficial effect on the phenomenon of migration from these regions and on the preservation of the environment. That is, the technology in question is a clean one, which generates electricity directly from an inexhaustible source by means of equipment that is simple and reliable, even though still expensive at present. According to the latest studies, in the short run a market can be expected of 40 MWp (Wp: maximum available power under standardized test conditions: mW/cm^2 at 25 degrees C cell temperature) in the sector of supplying electric power to isolated regions of the Community.

Given costs of 8 ECU/Wp [European Currency Units/Wp] per module, at present only low-power systems of up to 1-1.5 kWp are economical. Thus possible applications may involve supplying electricity to households in isolated regions or power for purposes of industrial or agricultural units that are more than 2 km away from the power-distribution network, as well as seawater desalinization, telecommunications connections, water pumps, irrigation facilities, or lighthouses. By a lowering of costs to 1-1.5 ECU/Wp, larger markets would open up for photovoltaics.

The technology of photovoltaics is dominated at present by crystalline silicon. The technology of amorphous silicon could distinctly lower the costs, but the durability of these systems has yet to be demonstrated. In this connection there are still serious reservations. The research and development work must be continued further in this area. This is true also of the high-power cells.

It might be possible to achieve a better position for photovoltaics on the market by getting those public utilities in charge of supplying electricity to rural areas interested in photovoltaics and its increased use. Moreover an effective infrastructure of producers and installers at a regional and local level must be created that will provide reliable systems and will be able and willing to service the equipment after delivery. Furthermore, the industry of the Community must make considerable efforts to strength its position in the world market now dominated by Japan and the United States.

Use of Energy From Biomass and Wastes

Biomass and wastes are understood to mean not only plants in general, but also wastes of agriculture and forestry, of the lumber industry, of the agricultural food processing industry, as well as the organic portion of municipal wastes. Their theoretical energy potential in the Community is considerable and on a long-term view amounts to about 100 million tons of ROeE. Only a fraction of this potential is currently being exploited in the Community, although the quantity that can be economically used even now is estimated to be 40 million tons of ROeE. But this potential cannot easily be checked out, especially since the available statistics are not very suited to this or are incomplete (the actual firewood consumption is said, for example, to be far greater than what follows from the statistics). More exact estimates of the theoretical and actual energy potential of biomass on a regional and national level are needed.

The generation of biomass and the energy exploiting of biomass and wastes is possible with the aid of a multitude of various technologies, which can be divided up roughly as follows:

—High-energy crops;
—Thermochemical conversion (combustion, gasification, pyrolysis, carbonization);

—Biological conversion (generation of biogas, production of motor fuels and chemicals such as ethanol, production of compost).

These separate technologies have matured to varying degrees and are scoring varying economic successes. The technically most fully matured and probably the most cost-effective methods of the use of energy from biomass and wastes are combustion and the recovery of biogas from monitored wastes or sewage of the agricultural food processing industry. The short-term development of the energy use of biomass and wastes will be based essentially on these conversion technologies; for all other methods of conversion, additional research and development work or demonstration projects are needed.

Aside from the problems common to all renewable energies, essentially the following facts stand in the way of an increased energy use of biomass and wastes:

1. The high collection, transport, and storage costs in relation to the small energy density of this energy source;

2. The productivity of the high-energy crops, which is still too low economically;

3. Corrosion or erosion problems from the material used and problems of air pollution due to smoke produced in the combustion of municipal wastes or fuel from trash (BRAM) (but technical solutions already exist);

4. The lack of trained personnel for the upkeep of facilities for recovering biogas in agricultural enterprises.

Furthermore, the fact must be underscored that the future of these renewable energy sources depends directly on our joint agriculture policy in the sector of alternative possibilities for using the soil, as represented, for example, by high-energy crops, crops for the bioindustry, or recreation grounds in agricultural bordering regions or surplus areas (it is estimated that by the end of the century there will be approximately 15 million hectares of surplus areas). Increased firewood consumption must likewise progress in harmony with the forestry action program of the Community for forest tending and forest use that is to be submitted to the Council by the Commission.

Geothermal Energy

The potential of geothermal energy at the low and intermediate temperature level for space heating and for applications in the agricultural industry is geographically relatively widely dispersed throughout the Community. But energy sources at a high temperature level, which are used for electric-power production, exist only in certain regions. These sources, which are grouped together in the Community Atlas (Doc. EUR 6578) into approximately 40 economically usable regions, could contribute 5 million tons of ROeE annually to the energy balance of the Community. Dry rock (HDR), a third, relatively frequently occurring energy source whose economic exploitability is likely to be proved by current research work, could increase this potential considerably more.

Furthermore, for the sake of better information data banks should be established concerning exploitable and already used sources. These data banks ought also to record the geological and geophysical data that has emerged from the Community's hydrocarbon research.

For some years now, wherever biothermal [sic: geothermal?] reserves have been exploited certain difficulties have arisen in connection with projects in the low and intermediate temperature range, especially in the reinjection of the fluids after their utilization, and problems due to corrosion. But these difficulties do not seem to be insurmountable, and through the current research, development, and demonstration programs the surmounting of these problems is likely to draw closer. Furthermore, the development of technologies adapted to the utilization of geothermal energy (pumps, heat exchangers, and so forth) should be pursued further.

Aside from the problems applicable to all renewable energies, the most important problems that specifically concern the development of the exploitation of geothermal energy are financial and economic problems. In connection with financing, one problem is that the major part of the capital expenditures—namely those for the drillings, which can total as much as 50 percent or more of the total costs—are capital expenditures that carry a geological risk. The costs for a single drilling that is to be developed for exploitation can amount to 1 million ECU for a drilling depth of 1,000 m. Systems of guarantees in the form of insurance policies against geological risks ought to be created, especially for district-heating projects done by local authorities.

So far as the economic side is concerned, the savings will perhaps be slight in view of the current prices for competing energy sources and the amortization of the high capital expenditure costs. In the next few years the exploiting of geothermal reserves situated near the surface in the low-temperature range and with not very corrosive fluids should be given priority, in order to lower as far as possible both the risk and also the initial capital-expenditure costs, and to enlarge and consolidate the number of geothermal projects taken advantage of.

Wind Energy

Because of the great wind-energy potential in the European Community and its present growth, a contribution of roughly 1 percent of the electricity consumption—that is, 2-3 million tons of ROeE—can be anticipated for the year 2000.

Two markets exist: A market for autonomous wind power plants for supplying power to isolated regions (for example islands) or for specific applications (pumps,

irrigation, cooling, heating). The wind plants in question here are those that generate between 3 and 300 kW, and these are likely to be used generally as a supplement to a diesel engine. The second market pertains to wind power plants that are connected up to the power-supply system. Here there are two possibilities: Either plants of a few hundred kW are used, or a smaller number of more high-powered plants of 1 MW or more are employed. It is yet to be determined which of these two possibilities is the most economical.

In the Community the wind power plants generate power of 3-3,000 kW. The plants with a power between 3 and 300 kW are already available on the market today. But in order to achieve a lowering of the costs of the generated energy, the wind plants must be improved at many points. They must become more powerful, their availability must be increased, and their maintenance costs must be lowered. Technological developments will lead to increasingly larger wind power plants (3 MW or more) with increasingly simpler equipment.

In certain out-of-the-way regions (for example the islands of Greece and Scotland) energy generation from wind power is cheaper than by way of diesel units. As for delivery to the power-supply system, the price of the generated electricity (between 0.03 and 0.05 ECU per kWh) is comparable to the production costs of coal power plants. An installed power of 1 KW costs less than 1,000 ECU in most cases.

Chief obstacles to the rapid development of wind energy emerge from the fact that for many sites a building permit is difficult to get—above all for environmental reasons—and from the fact that there are too many manufacturers of wind power plants in the Community compared to the potential market. Furthermore, in some member states certificates for wind plants are required, something which is restricting inner-Community exchange at present.

Water Power

Almost all the economic sites for hydroelectric power plants of intermediate and high power (over 10-15 MW) are being exploited at present. On the other hand, a relatively large potential of sites for low-power hydroelectric plants (approximately 4-5 GW [sic]), which are scattered throughout the Community, either have never been utilized or have no longer been exploited for some decades now. The potential production of these sites could meet a few percent of the power needs of the Community (3-4 million tons of ROeE).

The utilization of these sites is attractive above all to central, regional, and local authorities, to whom it can bring additional revenues, and to small and middle-sized companies, which will be able to lower their energy bill by these means. These are often multifaceted projects (for example, combined with irrigation systems or drinking-water pipelines), which thereby become even more economical.

The capital expenditure costs are relatively high. The specific construction costs are currently running mostly between 1,200 and 1,600 ECU per kW (depending on the site)—that is, perhaps 20-60 percent higher than for large nuclear or coal power plants—and the production costs frequently are greater than the initial costs for large thermal power plants. For autonomous operators, there is the advantage that the production costs are nevertheless still far below the selling prices set by the public electric-power producers.

The electromechanical equipment sector has been able to reap technological benefits from innovations in turbine manufacturing and in control and operating systems. In order to be able to stand up to the competition in the world market, computer science—above all computer-aided design and computer-aided manufacturing—should be used more and more. In addition, later on composite materials should be developed in turbine construction, since this would bring advantages and savings in fabricating and maintaining such equipment.

Moreover the further development of these projects presupposes a good knowledge of the energy sources involved. Several countries have carried out studies in the past; the updating and above all the improving of these studies (effects on the environment, exploitation possibilities, savings) are important. In addition the energy that can be generated ought to be systematically recorded, and data banks for the storage, processing, and dissemination of this information ought to be planned.

IV. Concluding Remarks

From the above sections, the following conclusions can be derived:

Based on the present state of the technologies involved, renewable energies can make a useful contribution to the energy supply of the Community; this contribution varies depending on the country, but evidently it will not exceed a few percent by the year 2000. But in the more distant future the potential that is in all probability usable and the technological advances that can be expected could lead to a greater contribution.

The development of the exploitation of renewable sources of energy has been able to profit from the various energy crises, thanks to the programs that were executed. But this development has begun to suffer from the consequences of the price changes of recent years in connection with conventional energies, and there is the risk of a further considerable slowdown, which may jeopardize the results already achieved, may induce our researchers and engineers to abandon their activity, and may irrevocably weaken the young equipment-making

industry for renewable energy sources. This is all the more serious since this industry has a considerable potential for growth, which can fulfill needs of the developing countries as well as of the Community.

Furthermore as already mentioned above, there exist a number of obstacles that are not directly connected with the competitiveness of such energy sources. These are primarily: The lack or unsuitability of legal or administrative procedures, hindrances to the free circulation of these facilities that is being aimed at through the perfecting of the internal market, the conditions imposed for the acceptance of the electricity generated by renewable energy sources before it is fed into the public power network, the lack of knowledge about the potentials and possibilities of these energies, especially on a regional and local level, and the lack of appropriate financing options.

As concerns the techniques for the exploitation of the renewable energy sources, their employability has been demonstrated in many cases; in other cases fully developed and more efficient technologies can be expected so long as the efforts in the sector of research, development, and demonstration are sustained. In this connection the Community programs play a crucial role. Furthermore mention must be made of the Community program VALOREN, which provides measures for encouraging the exploitation of the local energy potential in disadvantaged regions.

The further development of renewable energies must be continued by means of effective and large-scale projects. The relaxation in and current supply on the market of conventional energies may continue for a certain period, which is difficult to predict but is certainly not unlimited. In addition these energies are not inexhaustible. Now we must without delay take those measures that will improve our future energy supply through greater diversification and an optimal utilization of our resources. The promotion of renewable energy sources is a long-range task; it must not depend on chance events or expect decisive results in too short a time.

A prerequisite for the success of such a program is that responsible parties in industry, decision-makers, and the public in general will be able to form for themselves a concrete picture of renewable energies. At present there is no clear notion about these energy sources, which are regarded as indistinct and uncertain and are relegated more to theory than to practice. This can be explained in part by the fact that renewable sources of energy are not mentioned in the statistics on traditional energies and that in most countries reliable inventories of the unused potential are lacking. It is possible and necessary to eliminate these deficiencies. The additional creation of national organizations for promoting the use of renewable energy sources would underscore the realistic nature of this option and would provide at the same time the possibility for channeling the efforts on the side of the governments with those of industry.

The following proposal was drawn up with the above considerations in mind. It is based on some general recommendations for a decisive and comprehensive policy for developing renewable energies. Later the Commission wants to work out proposals on more specific topics, which are to be devoted especially to the elimination of the obstacles in the exploitation of the separate sources.

V. Proposal for a Recommendation by the Council to the Member States on the Development of the Exploitation of Renewable Sources of Energy in the Community

The Council of the European Communities

—on the basis of the agreement on founding the European Economic Community, and especially Article 235,

—on a proposal by the Commission,

—upon endorsement by the European Parliament,

recommends to the member states:

1. To create legal and administrative regulations or to adapt already existing ones with the objective of eliminating obstacles standing in the way of the development of the exploitation of renewable energy sources;

2. To continue the previous efforts through the further pursuit of research and demonstration programs, and to make assessments and adjustments periodically on the basis of the prevailing state of technology;

3. To complete the national recordings of renewable energy sources and to disseminate them as widely as possible on a regional and local level;

4. To promote cooperation among those industries that manufacture equipment for the exploitation of renewable energies;

5. To apply to equipment for exploiting renewable energies the informational procedures prescribed in Guideline 83/189/EEC ("Guideline of the Council of 28 March 1983 on an Informational Procedure in the Area of Standards and Technical Specifications") for drafts of standards and technical specifications, for the sake of the perfection of the inland market. Within the framework of these specifications and to the extent that trade barriers exist in the Community on equipment for exploiting renewable energies, the Commission will examine the advisability of a proposal for joint specifications for granting certificates;

6. In order to encourage the exploitation of these energies, to provide for appropriate contractual conditions with respect to the delivery to power-supply companies of energies generated on a private basis from renewable energy sources;

7. To take measures for the financial supporting of feasibility studies on projects for the exploitation of renewable energies, especially those of central, regional, and local authorities and small and medium-sized companies;

8. In concert with the resolution of 26 November 1986, to create public advisory services for working out feasibility studies and for the technical and financial realization of projects for exploiting renewable energy sources in those member states where these services are not in existence; these services ought to devote special attention to informing the public with respect to the concrete possibilities for an exploitation of these energy sources and the effects on the environment;

9. To facilitate the exchange of information on the development of the renewable energies among the member states and on a Community level, especially through agreements on access to national data banks; to support the Commission in the establishment of the Community data bank SESAME for projects that are carried out within the framework of national and Community programs;

10. In cooperation with the statistical office of the European Communities, to work out and introduce an appropriate statistical recording system for the renewable energies;

11. To report to the Commission periodically on measures taken or planned in the sector addressed by this recommendation and on achieved or expected results; in this connection the Commission will periodically hold meetings, on its own initiative or upon the request of a member state, on the exchange of information at the Community level, in order to ensure the coherence of these measures.

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FACTORY AUTOMATION, ROBOTICS

Report on 1988-1992 BMFT Research Program of Manufacturing Engineering

3698m390 Bonn TECHNOLOGIE NACHRICHTEN-PROGRAMM INFORMATIONEN in German, No 423, 5 May 88 pp 2-18

[Excerpts from TECHNOLOGIE NACHRICHTEN-PROGRAMM INFORMATIONEN]

[Text] **II. INITIAL SITUATION**

1. Introduction

The discussion about the "factory of the future" is to be viewed against the background of a basic change in industrial production. This is primarily characterized by the increasing transformation from a seller's to a buyer's market, which forces industrial enterprises to accommodate the customer's wishes to an increasing extent. This trend becomes especially clear through the following example of a German automobile manufacturer: Out of 3,500 cars produced daily, only five vehicles are the same (as regards variant and equipment). This number also shows the stringent requirements that are here imposed on the manufacturing system, e.g. with a view to planning, dispatch, material flow, control, and technology.

Nearly all businesses in the future will increasingly have to pursue the strategy of increasing the flexibility of their manufacturing and thus assuming the characteristics of a service enterprise. Here, we will have to start from the following developments:

- Products are becoming more complex and of higher quality;
- Quality requirements are rising;
- Product variants are increasing and the lot sizes are falling
- Number of units fluctuates;
- Innovation times are becoming shorter;
- Delivery times are becoming shorter and proper delivery is becoming more important.

The challenges sketched here can be met only with modern manufacturing engineering and with qualified and motivated people. Information, as an important manufacturing factor, here acquires a new quality and significance. Information technology becomes an important manufacturing component, which is already noticeably changing the factories.

2. Status of the Application of Information Technology

Under contract with the Rationalization Committee of German Business, a study is being performed which deals with EDP utilization and with computer-supported integration in manufacturing and management of industrial enterprises in the Federal Republic of Germany. Several thousand industrial enterprises are being addressed in a business enquiry; about 1,300 enterprises have participated. Industrial enterprises of the trades which produce capital goods are here represented.

In an evaluation, it could be determined that information technology in some form had penetrated most enterprises. In more than 90 percent of the businesses, at least one operating function is computer supported. Here, the sales and management areas clearly stand at the top. For the technical task areas such as design, manufacturing planning and control, and other areas preceding or following manufacturing, information technology is only being used in 10 percent to 17 percent of the businesses. In the area of manufacturing itself, there are big differences in computer application. Thus, CNC machine tools are used in more than one-third of the businesses; only about 3 percent of the businesses manage more complex computer- supported manufacturing

facilities, e.g. flexible manufacturing systems and cells. Up to now, few businesses have used computer-supported systems for transport, assembly, and parts handling; automated material flow systems exist in less than 1 percent of the businesses.

The application of individual computer techniques greatly increases with the size of the business. For example, computers are used in manufacturing planning and control, in the individual categories of business size (according to number of employees), as follows:

Number of Employees	Number of Businesses Using Computers, Percentage
1 - 19	1
20 - 49	6
50 - 99	9
100 - 199	21
200 - 499	31
500 - 999	52
1000 and more	69

As regards the use of computers in office and administrative functions, small businesses generally do not lag so far behind the large ones.

Computer-supported networking or integration of various functional areas of an enterprise is the next important step, and it stands at the center of the discussion that is being carried on concerning future concepts of applying information technology. The results of the study show that here we are just beginning our endeavour; only about 9 percent of the enterprises of the capital goods industry have implemented intra-operational connection—regardless of what type—in at least partial areas. Here, too, there is a clear dependence on the size of the business:

Size of the Business (Number of Employees)	Connection Implemented (Number of Businesses, Percentage)
less than 100	3.6
100 to 500	16.0
500 to 1000	31.0
over 1000	43.0

What is most frequently implemented is a linkage between computer-supported production planning and control systems and computer-supported work planning. Barely 4 percent of the businesses indicate that they have implemented this connection. The second most frequent linkage exists between work planning/NC programming and computer-supported systems in manufacturing and assembly, with about 3 percent of the businesses.

At the present time, there are as yet no data concerning the intensity and quality of the connections that have been made. So far in most instances probably just model solutions are being developed and tested in individual areas.

Connections within the enterprise predominate in networks which transcend the individual business. Other linkages, e.g. to customers and suppliers, scarcely exist at all yet.

3. Flexible Manufacturing Structures

In flexible manufacturing systems (FMS), several processing systems (e.g. machine tools) are integrated with respect to the information and material flow so that different work pieces can be fabricated automatically at the same time or sequentially in an arbitrary sequence. These are very complex technical systems; they increase productivity, shorten processing times, and increase the flexibility in the growing area of medium and small series production.

According to available studies, at the end of 1985 in the Federal Republic of Germany, 278 flexible manufacturing systems and cells were installed. Their application has risen strongly in recent years. Since 1983, their number has doubled. Flexible manufacturing cells and small FMS (up to a maximum of 5 machines) exhibit the strongest growth rate. The user enterprises predominantly (about 70 percent) belong to the machine construction branch. These manufacturing facilities exist mainly in larger enterprises with more than 1,000 employees. Only 2 percent of the systems are installed in enterprises with up to 100 employees.

With small and medium size enterprises, manufacturing is beginning to be made more flexible to an increasing extent with the data technology linking of CNC machines and supplementary conventional work stations in the form of flexible manufacturing islands. Automation of the material flow is reserved for a later expansion stage. This step-by-step procedure also permits small businesses to enter computer-supported manufacturing.

Especially high flexibility requirements are imposed on computer-supported manufacturing planning and control systems. The development tends to link central planning systems with decentralized fine control systems in partially autonomous operating working groups, by way of information technology. User friendliness and acceptance by the employees requires special attention in the design of these decentralized systems.

4. Machine Tools

One of the most important product groups in machine construction is the construction of machine tools. In 1986, this branch produced systems valued at about DM13 billion. About 61 percent of these were exported. The proportion of foreign machine tool products in the domestic market supply is increasing.

1983	29 % (machine construction total 38 %)
1986	36 % (machine construction total 41 %)

The share of Japan in these imports has increased:

1983	11 % (machine construction total 8 %)
1986	17 % (machine construction total 12 %)

In 1986, Japanese machine tools valued at DM499 million were imported, while the Federal Republic of Germany exported to Japan such machines valued at only DM208 million.

The 1987 world shares in the manufacturing and export of machine tools for some countries look as follows:

	Production	Export
Japan	20.5 %	20.0 %
Federal Republic of Germany	19.9 %	22.6 %
USA	7.8 %	4.4 %

Modern machine tools are computer controlled and are generally designated as NC machine tools (NC = numerical control). Such machines were produced in Germany in 1986 to a value of about DM5.7 billion; this amounted to about 44 percent of the total production value of machine tools. This fraction has risen steadily in recent years. In 1982, it was only 23 percent. The domestic supply with NC machine tools from German production shows the following development: 1984 76 percent, 1985 73 percent and 1986 73 percent.

The share of NC machine tools (NC-WZM) that is produced annually, within the total production of machine tools (relative to the number of units) changed in the following countries as follows:

	1984	1986
Federal Republic of Germany	14.2 %	17.4 %
France	3.7 %	6.7 %
USA	3.6 %	2.4 %
Japan	18.6 %	24.2 %

If the number of produced NC-WZM is referred to 100,000 inhabitants in the respective countries, the following values result:

	1984	1986
Federal Republic of Germany	37.3	36.0
France	3.0	4.7
USA	4.6	6.1
Japan	31.7	31.9

5. Industrial Robots/Handling Systems

In the Federal Republic of Germany in 1987, 2,670 industrial robots valued at about DM595 million were produced. Compared to the previous year, this was a decrease of the production value by about 7 percent. This corresponds to a development that can be observed world-wide. About 1,190 units (45 percent) were exported.

The number of utilized robots rose to 14,900 units in 1987 (determination by the FhG (Fraunhofer Society) Institute for Manufacturing Engineering and Automation (IPA)). This was 2,500 more than in 1986. This growth of industrial robots consisted 34 percent of imports (in 1986, the number was 36 percent). Of these, 16 percent came from European, 10 percent from the USA, and 8 percent from Japan. Out of the total number of units, 37 percent were imported (18 percent from European countries, 11 percent from the U.S., 8 percent from Japan).

The number of industrial robots used per 10,000 employees in manufacturing, for the year 1986, can be broken down as follows (source: FhG-IPA):

Federal Republic of Germany	14.4
Sweden	39.0
Italy	9.3
Great Britain	5.8
USA	11.4
Japan	78.0

III. MEASURES IN PROGRESS

In Germany

1. Research

Basic research and applied research in the area of manufacturing engineering are being carried on in the Federal Republic of Germany by a series of university and Fraunhofer Institutes with a high national and international reputation.

In recent years, the Fraunhofer Society has significantly expanded its research and development capacity in the special areas of manufacturing automation and manufacturing technologies. In 1987, ten institutes with over 1,000 employees worked in these special areas. Operating expenses for these institutes in 1987 amounted to about DM130 million.

University institutes with a manufacturing engineering orientation employ approximately 5,200 employees, of which about 3,000 are scientists.

The German Research Association (DFG) funds basic research in manufacturing engineering as a standard procedure, in programs of special emphasis, and in special research areas. In 1986, it approved DM47.7 million for this.

Altogether one can say that a solid base exists in Germany for basic research and for applied research in the area of manufacturing engineering.

2. Professional Training

In 1985, the Federal Minister for Education and Science started the action program "New Technologies in Professional Education." This program comprises research projects, model experiments in business and in professional schools. Among other things, training and continuing education programs for CNC and CAD technology as well as for memory- programmable controls were initiated and accelerated by this funding. One research project had as its object the development of continuing education concepts for the introduction of computer-integrated organizational structures in medium businesses of contract manufacturing. In discussions among experts, the necessary functional displacements in the course of computer-integrated linkage of individual working areas (e.g. marketing, design, work preparation, quality control or calculation) were investigated and the qualification requirements arising in this connection on the basis of other interfaces in the organizational execution sequence were redefined.

3. Manufacturing Engineering Program

From 1984 to 1988, the BMFT made available a total of DM610 million for the manufacturing engineering program.

The essential focal point of this program is the indirect-specific funding of the application of CAD/CAM systems in manufacturing engineering enterprises, as well as the development of industrial robots/handling systems. For more than 1,300 enterprises, from 1984 to 1988, about DM450 million have been made available. These measures reach primarily small and medium enterprises. About 90 percent of the funded enterprises have yearly sales of less than DM200 million.

Another focal point of the program funds cooperative joint projects, to solve future-oriented company-supervening questions of modern manufacturing engineering. The work concentrates on progressive handling technology, assembly technology, flexible manufacturing, safeguarding the manufacturing process, and key technologies for manufacturing. A total of DM125 million has been approved for 19 joint projects. These cooperation efforts have turned out well.

The possibilities of technology transfer were expanded to speed up the realization and dissemination of R&D results. Thus, the CAD/CAM Laboratory in Karlsruhe is informing potential manufacturing users of CAD/CAM and production planning and control systems—espe cially medium enterprises—concerning the capabilities of this technology. In 1986, about 160 events were held; up to now, more than 18,000 persons have visited this laboratory. A special model experiment investigates and tests how the know-how of a university in the CAD-/CAM area can be transferred into professional training and further education.

The question of technology design is generally formulated either project- specifically in association projects or in special studies.

To increase the funding of basic research in manufacturing engineering, the German Research Association is making available special means (DM23 million for 1986 through 1989). These means are intended to emphasize the programs:

- process data processing in manufacturing engineering;
- diagnostic systems for machines and systems;
- planning and control methods in indirect manufacturing areas.

In important manufacturing engineering areas, this program has speeded up the innovation process. This process must be continued; especially the integration and coupling of different operational function areas by means of information technology presents major challenges to the enterprises—especially small and medium businesses.

4. Laser Technology

Laser technology is playing an increasing role in manufacturing engineering tasks. For this reason, the BMFT has set up the funding focal point "Laser Research and Laser Technology." This measure concentrates on sources of laser radiation and components, application techniques, and system integration, as well as laser measuring techniques and laser analytics. About DM194 million are made available for the period from 1987 to 1990.

5. Measures in Other Countries

The central significance of manufacturing engineering for the competitiveness of the economy has been recognized by the governments of all industrial nations.

Some measures in other countries will be listed below:

The United States

The United States is broadly supporting manufacturing engineering within the framework of various programs of the Defense Department. Thus, the procurement measures for the navy, air force, and army also comprise the development and application of modern manufacturing techniques in industry. The financial means involved here are considerable. Thus, the navy plans to equip its developers and engineers with CAD/CAM systems. From 1988 to 1993, about 2 billion US dollars are to be furnished for this. It is estimated that by 1990, this will make up 20 to 30 percent of the US market of computer-supported work stations for technical tasks.

The National Science Foundation is also funding research in the area of design, manufacturing, and automation; for the period 1985 to 1987, about 58 million

US dollars were made available for this. The funding means for machine construction altogether amounted to 499 million US dollars over the same time period.

The National Science Foundation is preparing a strategic plan for the engineering sciences. The following tasks stand in the forefront here:

- improvement of engineering education;
- deepening the scientific basis in important technological areas such as design, manufacturing, and computer-integrated manufacturing;
- stimulating technical innovation;
- improving inter-disciplinary research.

This plan is supposed to have a running time of five years; the financial need is specified at $550 million annually.

Japan

The Ministry of International Trade and Industry in Japan is funding a series of larger and more long-term projects, which are related to manufacturing engineering. The project "Flexible Manufacturing System Complex Provided with Laser" was concluded in 1984. It was supported with about DM140 million. About DM160 million were furnished for the project "Optical Measurement and Control System;" it was completed in 1985.

Since 1983, the project "Advanced Robot Technology" is running with a funding sum of about DM250 million. It is developing robot technologies for workers under extreme environmental conditions. It will end in 1990.

The objective of the project "Automatic Sewing System" is to develop key technologies for the automation of textile processing. About DM120 million are available between 1982 and 1990.

In 1986, the project "Advanced Materials Processing and Machining Systems" was started with DM0.25 million. For its eight year running time, a funding need of about DM170 million is specified.

The projects named here are implemented within the framework of 100 percent financed development contracts. Considerable expenditures on the part of business are reduced through their organization as association projects, in which generally government R&D centers and private businesses both participate.

Great Britain

Technological development in Great Britain is supported mainly by the Department of Trade and Industry; cooperative projects are increasingly moving to the forefront.

For the area of machine construction, the objective is being pursued of developing and making available for broad use progressive manufacturing technologies. Points of emphasis are the CAD/CAM area, flexible manufacturing systems, industrial robots, as well as the automation of welding and assembly tasks. The electrical engineering industry is being called upon to participate in European programs. Industrial competitiveness is to be increased by stimulating innovation. For both industrial areas, standardization is especially important. The funding means for the period 1987-1989 total about 60 million pounds.

Research and development is being funded in a special program, in order to improve the competitiveness of the textile industry and other manufacturers (e.g. leather-, furniture-, packing-, and paper-industry). The funding is channeled predominantly through research associations. For 1987 to 1989, about 30 billion pounds are available.

Measures for technology transfer, for education and further training, as well as for consulting services, play a special role. About 14 percent of the total budget of the Department of Trade and Industry (about 422 million pounds in 1986) are expended for this purpose.

France

In France, development of modern manufacturing engineering is supported by several institutions (e.g. the Industrial Ministry, the Research Ministry, research organizations). The Industrial Ministry supports R&D work in the following points of emphasis:

- memory-programmable controls;

- computer-supported development and design;

- local industrial networks.

The following funds were made available: Fr146 million in 1985, Fr126 million in 1986, and Fr126 million in 1987. The funding projects generally have a running time of three years. Furthermore, industries are granted financial support for modernization investments in manufacturing engineering (e.g. procurement of CNC machine tools). About Fr100 million per year are available for this.

6. EC Commission Measures

The area of manufacturing engineering is addressed in the following two programs:

ESPRIT

The ESPRIT program [European Strategic Program for Research and Development in the Area of Information Technologies] is an industrial cooperative program with the objective of promoting the information-technical

industry of the European Common Market. The program was started in 1984; the last invitation to bid on the first program phase was 1986. The second phase will presumably begin in 1988 and has a running time until 1992.

Manufacturing engineering developments are found especially in the focal point: "Computer-Integrated Manufacture" (CIM) with the areas:

- CIM architecture and communication;
- manufacturing system design and utilization;
- product design and analysis systems;
- planning and control of manufacturing processes;
- industrial robots and hall conveyor systems.

For these areas, funding means in the amount of about 173 million ECU total are provided for the period 1988 to 1992; this is about 16 percent of the ESPRIT II budget that has been provided for project funding.

The Commission tries to achieve stronger participation of small and medium businesses in the funding measures. This is supported by the project manager for manufacturing engineering, the Karlsruhe Nuclear Research Center. The project manager is available to interested parties as an information and communication agency.

BRITE

The BRITE program [Basic Research in the Area of Industrial Technologies for Europe] was decided upon in 1984; it has a running time of four years and has available financial means amounting to DM125 million.

The following manufacturing engineering topics are contained in it:

- reliability and wear of materials and components;
- laser technology and its application;
- joining techniques;
- new test methods;
- CAD/CAM and mathematical models;
- new manufacturing techniques for products made of soft-bending parts (e.g. textiles).

The information and contact agency in Germany for this program is the Project Manager for Materials Research, Juelich Nuclear Research Facility.

IV. EVALUATION OF THE SITUATION

In many important key areas, the industry of the Federal Republic produces top products and can offer them successfully domestically and on the world market; the high export rates underscore this. A solid basis exists here with us for basic research and applied research in manufacturing engineering.

However, the maintenance of competitiveness is more difficult. The increase of the proportion of foreign products in the domestic market supply in especially significant technological areas makes clear a trend that must be followed carefully and which makes purposeful efforts necessary.

About 50 percent of employees who work in processing trades are occupied in small and medium businesses. These businesses play a leading role in our economy for vitalizing investments and growth, as well as for the creation of jobs and training opportunities. In machine construction, too, their significance can be seen in terms of their growing share of employees and sales. Thus, in 1972, about 22 percent of employees in machine construction were employed in businesses with up to 200 employees; in 1985, the figure was 25 percent; the sales share of these businesses in 1972 was about 19 percent, and in 1985 about 22 percent. However, these figures also show that small and medium businesses participate to a below average degree in sales of the machine construction business; this could be an index for below-average work productivity in these enterprises.

If one considers the status of applications of modern technologies (e.g. information technology, flexible manufacturing systems) in the manufacturing of the enterprises, one can see in fact that the small and medium businesses are just making a beginning here. Even larger businesses have been able to implement only initial solutions in complex areas which are gaining in significance (e.g. with computer-supported integration of various production functions).

Industrial enterprises will maintain their position and will achieve a competitive advantage only if they produce innovative products as fast and as economically as possible, in accord with market requirements. This requires the capability of achieving an optimization between the following partly contradictory objectives:

- fast conversion of manufacturing equipment;
- high workload for the operating means;
- shortening the processing and thus the delivery times;
- improving adherence to deadlines;
- reducing inventory in stock;
- rapid application of volume manufacturing technologies;
- guaranteeing uniform high product quality;
- reduction of costs.

To solve the problems addressed here, a development has started here with us and also world-wide, which is characterized by the term "computer-integrated manufacturing" (CIM). This means that all operating areas of an enterprise that have to do with manufacturing are connected by means of data technology. The aim of this strategy is to optimize the manufacturing process as a whole, in order to reduce costs and processing times, and in order at the same time to increase productivity, quality, and flexibility.

When optimizing the entire logistical chain, it is also important to built a network across the whole enterprise. This concerns specifically the collaboration between large enterprises and their suppliers, the small and medium enterprises. Large enterprises, e.g. in the automobile industry, have taken over a vanguard role with CIM; their suppliers must be able to keep step so as to remain capable partners also in the future.

When implementing CIM, one tries to link by information technology the existing and planned "automation islands" of the enterprise (e.g. in the areas of development and design, manufacturing planning and control, process automation in manufacture), step-by-step or in a manner specific to the particular business. However, what is involved here is not only the installation of communication networks and computer links, but especially also the integration of work processes and the creation of entirely novel work patterns. But then the organizational forms and management instruments would also have to change. The complex interaction between the mature organizational structure of a business, the design of computer integrated systems, and the concomitant organizational work possibilities must be taken into account in the CIM plans. Here, design potentials can be used and introduction problems can be reduced.

Initial studies concerning possible improvements by CIM have shown the following:

- 15 % to 35 %	Cost reduction in technical functions
- 50 % to 60 %	Shortening of processing times
- 50 %	Reduction of rejects
- 20 % to 30 %	Reduction of working capital
- 50 % to 80 %	Reduction of delays in orders

Traditional thinking about costs alone cannot describe the special features of CIM, however. New formulations of economic thinking are necessary here. Initial concepts are being discussed, and these must be developed further.

CIM is not supposed to create non-transparent, complicated super-systems with central control. Rather, the close collaboration of autonomous transparent sub-systems should facilitate a new dimension for the future development of our factories. Primarily such enterprises will persist in competition in the markets, as begin soon with this evolution process and execute it with all speed. Because of the increasingly more rapid development of information technology, innovation jumps result which cannot be escaped. The rapid solution of the very know-how intensive tasks that are involved here poses a substantial problem, especially to small and medium businesses.

What innovation hindrances can be recognized?

Lack of Knowledge and Experience in the Enterprises

The diffusion of CIM technology has just begun. Experience in the businesses does not exist at all - except for a few large enterprises. The employees are not sufficiently trained in this area. Nevertheless, to give these businesses a chance of utilizing the possibilities of this technological development quickly, one must start from the following consideration:

—The point of CIM is to integrate the various operating departments and facilities of a business in a manner specific to that business. The problems, advantages, design and solution possibilities of CIM must be presented and demonstrated to its potential users—especially in small and medium businesses—in a practical and clear manner, so that they can make preparations for their business decisions.

—The employees in the business must be offered qualified information opportunities and seminars, to build up a solid basic knowledge of CIM.

For medium and longer term development, training and higher education concepts must be adapted to the changing requirements.

Lack of Standardization

With CIM, very different manufacturing engineering components and equipment, offered by various manufacturers, must be integrated. Thus, standardization is especially important. An important precondition for the smooth interaction of manufacturing equipment is the ability of the individual automation components to communicate among one another and to communicate with the computer-supported systems in the technical office. Rapid development of information technology demands concomitant standardization work. However, the potential users must also be supplied with handling instructions in the short term.

The CIM Commission in the German Institute for Standardization has developed a concept for CIM standardization.

In order to be able to utilize fully the opportunities of CIM technology in an open, competition-oriented market, it is necessary to develop and standardize the interfaces between the system components as much as possible on a European and international level.

High Economic Risks

There are no readily available solutions for CIM applications, solutions which can be bought and applied. First of all, the operating sequences, the organization, and the existing product equipment must be analyzed and evaluated for each business—starting from the business

strategy, and a CIM implementation concept must be worked out. This preliminary work already requires considerable effort, without a corresponding utility resulting from it immediately. After this, available CIM components are investigated, are selected in a manner specific to the business, are adapted, are possibly developed further, and are used in initial steps. External consultation and the training of employees are necessary here, possibly also new solutions in the personnel area.

The expenditures involving personnel and finances, which are necessary in this entry phase, involve a high risk for the enterprises, since the direct usefulness of the new technology cannot always be demonstrated—espe cially in the starting phase. Because of possible changes in operations, the employees can lose their security through CIM as regards their functions, responsibilities, and coordination tasks.

Consequent measures and consequent costs are not immediately and reliably recognizable. Especially small and medium businesses consequently hold back from initiating this technology-oriented restructuring process.

Besides CIM development, the evaluation of the present situation especially involves two further topics of the production area: assembly and manufacturing technologies.

Assembly

In many areas of industrial production, assembly costs make up between 20 and 50 percent of the manufacturing costs, with a rising trend. The degree of automation in assembly is still low. Thus, assembly in industrial production is the area with the greatest modernization potential. The competitiveness of our industry is significantly determined by an accelerated future-oriented solution of the assembly problems.

Automation of assembly requires an integrated use of top technologies, such as e.g. robot technology, sensor technology, computer-aided engineering, industrial networks, picture processing, and artificial intelligence. Flexible assembly automation is thus a technological challenge for manufacturing engineering of the 90's.

This area is subject especially to the following obstacles to innovation :

- lack of suitability of the products for assembly automation;
- lack of flexibility of technical equipment as regards product variants;
- lack of joining methods that are suitable for automation;
- high economic risk.

Manufacturing Technologies

New manufacturing technologies and machine systems are required to increase the performance capability of working and refining processes, to be able to process new materials economically, or to be able to produce new and better products by much higher precisions. The development of such technologies, which are characterized by clear development jumps, is very expensive and full of risks and requires the collaboration of various special disciplines. Small and medium businesses are frequently overstrained in solving these problems by themselves. They must be afforded the opportunity of developing such future oriented technological solutions jointly in cooperative projects with other businesses and with scientific institutes.

V. FUNDING CONCEPT

The contents and methods of funding measures will be described below. The given possibilities for cooperation in the national and international—and especially European—context are an opportunity that must be used.

1. Computer-Integrated Manufacturing (CIM)

Extensively Effective CIM Technology Transfer

Potential users of CIM should be able to inform themselves comprehensively concerning the possibilities of this technology. In order to speed up industrial application of the technical and experiential knowledge of the relevant research institutes, an initiative should be started and implemented, whose center point comprises the following tasks:

—General information concerning the development state of CIM (e.g. development trends, R&D results, experience);

—Organization of seminars (e.g. introductory meetings on important CIM topics, publication of seminar documents);

—Demonstration of exemplary CIM solutions (e.g. presentation of integrated CIM basic modules, practical exercises on and with CIM devices and equipment);

—Orientation consultations concerning the basic procedure in the preparation of CIM concepts, with inclusion of the necessary qualification measures (the subsequent detailed consultation which is specific to the particular business will be offered by appropriate commercial enterprises);

—Organization of meetings to exchange information about CIM.

This technology transfer will draw upon institutions which:

—have available extensive technical and experiential knowledge to a high degree and
—are already largely equipped with machines and devices for exemplary demonstration.

Primarily the institutes of the university group on manufacturing engineering suggest themselves here, who employ a total of about 1,300 employees (of these about 70 scientists), and which already have available CIM technical investments valued at about DM100 million. The intention is to draw upon these institutes as a basis of CIM technology transfer. This means that transfer agencies will exist in presumably 13 locations (Aachen, Berlin, Bochum, Dortmund, Braunschweig, Darmstadt, Erlangen, Hamburg, Hannover, Karlsruhe, Munich, Saarbruecken, Stuttgart). These locations at the same time guarantee a balanced regional distribution over the federal area.

Other chambers of industry and commerce, trade chambers, the Rationalization Commission of German Businesses (RWK), the Association of German Machine and System Instructors (VDMA), the Association of German Engineers (VDI), and other associations are planning to organize CIM information meetings and CIM experience groups. They are being offered joint use of the facilities of the institutes at the above locations and they are encouraged to prepare and implement meetings jointly.

Standardization in the CIM Area

An export-oriented country, such as the Federal Republic of Germany, is especially interested in developing and standardizing interfaces on the European and international level. EEC directives oblige the member states to notify the EEC Commission of Standardization projects. In areas for which the Commission of the EEC assigns standardization tasks to certain institutions, the others have to maintain an "obligatory standstill." The federal government, in its contacts with standardization organizations and the EEC Commission, will try to fit the standardization work within the European and international environment. The results of the work should be included as early as possible in the European and international standards, so as to avoid incompatible national solutions.

The conception of European joint projects for standardization in the CIM area, which are implemented as a joint labor by industry and science, is therefore urgent. The stimulation and financing possibilities, which the Commission of the EEC here offers, e.g. with ESPRIT, should be utilized. The Project Manager for Manufacturing Engineering of the BMFT, the Karlsruhe Nuclear Research Center, will here take over the function of exchanging information and inducing collaboration.

So that a well-founded scientific basis for CIM standardization will be available in the Federal Republic of Germany, a special CIM working team should be formed at a research facility that is especially suited for this. This team should work as a national research agency of industry, and should collaborate in the expert representation of the Federal Republic of Germany within the framework of international actions. The team will be set up for a limited time period—five to seven years—and the Federal Minister for Research and Technology will participate in its financing.

In addition, a staff position for CIM standardization should be built up at the DIN, supported by funds from the Federal Minister for the Economy. The task of this staff agency should be the coordination and management of standardization work and their inclusion in European and world-wide standardization organizations, as a central function of the DIN and in the individual standardization boards in question.

Indirect-Specific Funding of CIM Applications

This part of the funding concept is characterized by a simple procedure directed towards broad effects, in which the individual entrepreneurial decisions are left to market forces. It serves the purpose of stimulating accelerated development and application of computer-integrated manufacturing. The inherent initiative of the businesses is to be strengthened thereby, to enter quickly into the process of computer-supported manufacturing integration and thus into a future-oriented structural improvement. Especially small and medium businesses should be addressed here.

Group of Institutions Addressed:

The group of institutions addressed by the funding are legally autonomous enterprises of the capital goods-producing trades, which develop, manufacture and market or have marketed manufacturing engineering devices, machines, equipment, and/or the appropriate modules or aggregates (see appendix). The fraction of such products relative to the total sales of an enterprise must amount to at least 25 percent during the business year before submitting an application.

The measure concentrates on these enterprises because, as suppliers of productivity, they have a special key function for industry as a whole. Furthermore, they play an important role for the exports from the Federal Republic of Germany—about two-thirds of the production value is exported. Thus, these businesses are especially exposed to international competition on the world markets.

Further, it must be observed that our manufacturing engineering industry is predominantly structured on a medium level basis, more than 90 percent of the businesses have fewer than 500 employees.

Funding:

Development work to prepare and introduce computer integrated manufacturing in one's own operations should be funded. Computer integrated manufacturing is characterized by the information technology networking and linking of existing CIM components within the business. CIM components in the sense of this measure are autonomous computer-supported subsystems for operational tasks (e.g. accounting and financing; the production of offers and the administration of contracts; materials and timing, the planning and control of manufacturing, shipping, and customer service) or for technical tasks (e.g. development and design; work planning; manufacturing and assembly; quality assurance; material flow and stock maintenance).

The allocation extends to personnel costs, external costs for consultation, employee training, as well as R&D procurement contracts for software for the linking tasks. It amounts to 40 percent of the allocatable costs. The maximum allocation per business is DM300,000.

The funded projects must be implemented and utilized in the Federal Republic of Germany. The funding needs are estimated at DM300 million.

The procedure for executing this funding measure will be regulated by special guidelines.

2. New Production Technologies, Assembly

The development of especially progressive manufacturing technologies should be promoted in new national association projects. The points of emphasis will be reshaping manufacturing methods, manufacturing methods for composite materials and high-performance ceramics, as well as ultra-precision technology.

Within the framework of EUREKA, cooperation projects in the area of "flexible automated assembly systems" (FAMOS) should be supported. France, Great Britain, Austria, Sweden, Spain and the Federal Republic of Germany have jointly undertaken a preliminary study by way of preparation. According to this, research and development tasks of high priority exist in the following areas:

- Assembly planning
e.g. product design appropriate for assembly, planning and layout design of an assembly system, design of the work place, employee qualifications;

- Assembly systems
e.g. programming and control of assembly systems, system integration, quality control, and strategies for managing disturbances;

- Assembly technologies
e.g. handling systems, flexible gripping systems, sensor technology, in- feed technology, joining technologies.

In accordance with the EUREKA principles, it is the responsibility of industrial enterprises and research institutes themselves to find European cooperation partners and to prepare and agree to a collaboration for specific projects. However, the Project Manager for Manufacturing Engineering, the Karlsruhe Nuclear Research Center, here offers its aid—especially to small and medium businesses—through information and through support in the search for partners.

The current association projects should be concluded in accord with the agreed-upon working plans. The points of emphasis of these projects are given in Chapter II, in the section on "Program for Manufacturing Engineering."

New future-oriented problem definitions and questions that have emphasis on information technology should be solved in European cooperation. The funding offered by the Commission of the European Economic Community should be used here (e.g. ESPRIT). In the Federal Republic of Germany, the Project Manager for Manufacturing Engineering, the Karlsruhe Nuclear Research Center, will take over the task of an information and contact agency for the area of "Computer Integrated Manufacturing."

3. Further Measures

—Basic Research

The agreements, reached with the German research community, for increased funding of basic research on manufacturing engineering will be concluded in 1989 according to plan.

—Skilled Trades

Training and further eduction in information technology is also very important for the skilled trade professions. In a model project in the "Metal Center" of the Workshop Chamber of Koblenz, the appropriate training concepts should therefore be developed and should be tried out in practical use. Close cooperation with the RWTH Aachen is anticipated here. It must also be investigated how results from research and development can be speeded up in the future and can be transferred to the skilled trade practices.

—Bilateral cooperation

Developing countries have a great interest in collaborating with the Federal Republic of Germany in the area of manufacturing engineering. Scientific collaboration is especially of interest to both parties when realistic perspectives for industrial cooperation are opened thereby.

Cooperation with Egypt, Brazil, the People's Republic of China, Indonesia, the Republic of Korea, Venezuela are currently in progress or in preparation. Proposals for collaboration are also on the table from the German Democratic Republic and other CEMA states.

—Evaluating and Assessing the Consequences of Technology

In an effect analysis of the indirect-specific funding of CIM applications, their efficiency and effects should be investigated, likewise the relationships between the introduction of computer-supported systems in manufacturing and the operational organization, workloads, and qualification requirements. From this, recommendations for the shaping of technology, organization, and the structure of industrial enterprises should be derived.

VI. FINANCIAL PLANNING, EXECUTION

The following means are provided for financing these measures:

	1988*	1989	1990	1991	1992	Total
in million DM	32	125	125	130	90	502

*For 1988, another DM85 million have been allocated to finance still current measures (1984—1987 program).

Out of the total means, DM300 million are provided for indirect-specific funding.

The means cited for 1988 through 1991 are contained in the valid financial plan (Title 3004/683 23).

The means are subject to the continuation of the financial plan in future budgeting years.

The entire funding program is executed through the Project Manager for Manufacturing Engineering, the Karlsruhe Nuclear Research Center.

APPENDIX

Group of Institutions Addressed for the indirect-specific funding of CIM. This includes enterprises who produce the following products:

a): —Complete devices, machines, and equipment;
—Construction and construction material machines;
—Mining machinery;
—Printing and paper machines;
—Equipment for conveyance technology;
—Equipment for electroplating purposes;
—Equipment for lacquering and coating;
—Casting machines;
—Woodworking machines;
—Foundry and rolling mill equipment;
—Industrial furnaces and heat treatment equipment;
—Industrial robots as well as devices and equipment for assembly and handling;
—Agricultural machines;
—Machines for manufacturing electronic components;
—Machines for the shoe and leather industry;
—Machines to process rubber, plastics, glass and ceramics;
—Measurement and testing machines;
—Sewing and clothing machines;
—Foodstuff and packing machines;
—Textile machines;
—Machine tools and electrical tools.

b):—Subassemblies or aggregates for the devices, machines, and equipment named under a);
—Drives;
—Transmissions and couplings;
—Components for measuring, testing, monitoring, controlling, regulating;
—Pneumatic and hydraulic components;
—Products of tool and die manufacture

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New Robotics Equipment at FRG's Fraunhofer, Netherlands' Philips

CIM, LAN Presented at Hanover

36980309 Duesseldorf VDI NACHRICHTEN in German 29 Apr 88 p 5

[Article by Siegfried Kaempfer: "Computer-Integrated Manufacturing as a Trade Show—Even Two Times CIM is No CIM—The Computer-Integrated Factory of the Future Also Remained a Mirage in Hanover"]

[Excerpts] VDI-N, Hanover, 29 Apr 88—The CIM euphoria which has prevailed for many years is changing to the CIM reality very slowly. Twice this year the proponents of a factory of the future exhibited at the Hanover Fair: first for CeBIT and now for industry. The central agency Intermatic on the upper floor of hall 18 did exist two years ago—even though in a less complete version. However, users are still waiting for CIM: The CIM demonstrations which were designed specifically for the fair only give them reason for continued hope.

Professor H.-J. Warnecke explains why CIM is progressing so slowly: "Even if the technology is close at hand, organization and administration take time." Before a factory can be restructured a new thinking is required and therefore Warnecke believes: "It will probably take ten more years before CIM will be used on a broader scale."

The head of the Fraunhofer Institute for Production Technology and Automation (IPA) is one of the initiators of the special presentation "CIM-Factory with a Future" at the Hanover Fair. IPA organized the model factory and combined 13 international companies under one CIM roof.

During the Hanover Fair, manufacturing automation specialist Warnecke emphasized to VDI-NACHRICHTEN that there could be no factory of "the" future. There is continued change. Thus, the CIM show also presented itself as a factory "with" a future.

Engineer Karl-Heinz Konty, manager in charge of this area at the Hannover Messe AG, also sees CIM in a somewhat more differentiated light than many other publicity-oriented CIM-prophets: "The important point is that in addition to the "C" for computer technologies in manufacturing and also the machine-oriented "C" for control systems, i.e. computer-assisted numerical control, the "C" for communications must also be provided, i.e. networking methods in the industrial sector, and the "C" for connectivity, the ability to connect production islands."

In this area, the central agency with its association of many companies set standards, even though engineer Hans-Alwin Puetzfeld, responsible for the broad-band network Sopho-LAN-M which was installed by Philips-PKI knows that it will still take a few years before such local area networks are widely used. With its device adapters, PKI connects a number of systems via standard interfaces. The adapters are based on the IEEE802.4 token passing bus standard and are therefore a first step towards future MAP products. This manufacturing automation protocol is supposed to become the standard for data interfaces. However, many users who are already using the modern communications technologies are asking themselves whether the extensive MAP approach will be the only acceptable solution.

Dr Rainer Kaempf, for instance, who did the data technology networking for IPA's Intermatic system contributions believes: "We already have a base to start from. There will be several networks. Certainly also a MAP network."

In Hanover, IPA showed several actual production automation applications: Softwire, a sensor and control system for autonomous, driverless transport systems. An assembly cell for parts insertion and soldering of circuit boards using several industrial robots.

Proposs is an event-oriented production process control system for information and control integration of all subsystems of a highly automated manufacturing operation.

IPA's minifactory is connected to a VAX 11/750 host computer in Stuttgart via a network server by Philips and Postmodem.

Parts insertion into circuit boards is part of a circuit board manufacturing operation where Coscom Computer GmbH, the Research Institute Industrial Image Processing Hanover (FIBH), NCR and Informatik-Systemtechnik cooperate. They use a fiber optics network "Pernet"; it consists of 400 m fiber optics cables and 15 fiber optics communications computers (FOCC) installed by Informatik-Systemtechnik. Marketing manager Franz-Josef Winkler explains: "By using decentralized distributed network computers in a real-time ring system our network Libsy-Pernet is particularly well suited for safety-oriented production processes. Libsy-Pernet can be integrated into complex structures as a specific subnetwork."

For material handling, the circuit board manufacturing process was connected by a driverless transport system without lane lines; the IPA study group under engineer G. Drunk fed the 30 m x 10 m driving range into the host computer. The autonomous robot vehicle stopped at the six workstations and exchanged the work pallets.

The approach takes place in three steps: First, the vehicle uses its ultrasound sensor to get within 2 cm of the transfer station. Then, an optical docking sensor uses a hole-punched edge to control precision down to 2 mm. For sliding the pallets across, centering cones are used to obtain a positioning accuracy of .2 mm. This is sufficient for the robot to be able to reliably grip workpieces.

New Algorithms for Determining Robot Path

36980309 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 4 May 88 p 8

[Article by Hubertus Franke and Dr. Helge-Bjoern Kuntze: "A new Control Increases Efficiency of Robot Use—Fraunhofer Institute: A Concept to Reduce Data Transfer"]

[Excerpts] Handling the flood of data is a major problem for the electronic control of industrial robots. The Fraunhofer Institute for Information and Data Processing (IITB) in Karslruhe has developed a new process with which the number of data supplied by sensors can be considerably reduced without lowering quality. In this way, robots can work more efficiently and cost-effectively. For his work, Hubertus Franke received the Prize of the Support Association FIZ at the Research Center for Information Sciences Karlsruhe. The following article describes the new control process. (The editors.)

Overcoming the resistance against new technologies which still exists in industry is a major goal of the research activities of the Fraunhofer Institute for Information and Data Processing (IITB) in Karlsruhe. One contribution was the multi-processor robot control which was developed as part of a contract research project for industry and which can be flexibly adapted to

various manufacturing problems and sensor configurations because of its modular multi-processor structure and the real time high-level language Pearl.

Another contribution is the development of a modular software package for the sensor-based machining of complex workpieces which was implemented and tested on the robot multi-processor control developed by IITB. The software package was used to support and/or control the generation and automatic execution of robot movement programs using various tactile or noncontacting sensors. It is organized into various compatible functional components.

During the automatic program-controlled movement of the robot hand along workpiece edges or contours two different malfunctions can occur which can be removed by static or dynamic sensor corrections. If the workpiece only shifted in its clamping device without a geometric change in the workpiece contour or edge which is to be machined a static sensor correction is sufficient. For this purpose, the sensor is activated only momentarily prior to machining in order to determine the relative workpiece shift which can be described by a correction matrix. Then, the path points which are stored in the program memory are corrected by adding them to this matrix and are travelled automatically without using the sensor. A typical application for this static sensor correction which was implemented at IITB using a light-section sensor is the path welding of small sheet metal pieces.

If the edge, contour, or surface of the workpiece to be machined is not known precisely or if there is an unpredictable change in the path geometry during machining, a dynamic correction of the programmed movement along the path is required. Using a tactile or noncontacting sensor the position of the robot hand relative to the workpiece is measured constantly during the program-controlled movement along the path. Based on the appropriate control algorithm possible deviations between programmed path and actual workpiece geometry are automatically deviation controlled.

However, because of the limited processing speed of presently available control and sensor computers such a deviation control is only possible for relatively slow path speeds (less than 100 mm per second). This means that a dynamic sensor correction can only be used for inherently slow machining processes such as path welding. This requires, however, that tool and sensor do not interfere with their respective functions, for instance, arcs interfering with image processing sensors. For processing tasks which are characterized by a complex path geometry, high path speeds and tight tolerance requirements, as for instance the application of adhesive, sensors can still be put to good use for the automatic generation of optimum movement programs. To generate such sophisticated programs an operator usually uses the teach-in mode and teaches each point individually with a handheld programming device at the workpiece. For larger, complex workpieces this requires a lot of time and can even take several days. Moreover, the path quality achieved depends to a large extent on the operator's qualification and experience.

Using sensors for path programming requires considerably less time and objectively improves path quality. The method for automatic path programming developed at IITB can be divided into three successive steps:

1. Sensor-controlled scanning with storage of path geometry. 2. Thinning out points depending on tolerance (data reduction). 3. Generating the movement program with a preset speed profile.

Step 1 measures the geometric path of the workpiece to be machined as precisely as possible. The workpiece is scanned automatically using the dynamic sensor control program described, and the distance and orientation of the robot hand to the workpiece should preferably agree with the subsequent program-controlled machining process. With a typical point distance of approximately .1 to .3 mm the dense sequence of points which was stored during the automatic scanning process describes the required geometric tool path with regard to orientation and position very precisely.

To obtain a path from this dense point sequence that can be traveled with the desired fast speed profile step 2 first thins the point sequence taking into consideration the permissible tolerances. Retaining the dense point sequence would cause serious memory space problems and limit the speed. By equidistant thinning (for instance delete every tenth point) the speed could be increased. However, the tolerance requirements could no longer be met.

The data reduction concept implemented by IITB thins the dense sequence of points in such a way that the position and orientation tolerance requirements are met reliably when interpolating the remaining points. The interpolation algorithm used for data reduction must agree with the movement program generated in step 3. The thinning density varies greatly with the path curvature.

To describe the position tolerance a tolerance tube is introduced. The orientation tolerance is best described by two tolerance cones. For this purpose, an orientation representation was developed which makes it possible to draw direct conclusions with regard to manufacturing precision in contrast to the orientation representation with Euler-angles which are commercially available. In addition, this creates a general basis for representation which can be easily implemented regardless of the type of control used.

The path points obtained by data reduction in step 2 can meet the tolerances required for position, tool incline and transposition only statically. The dynamic precision that can be obtained in program-controlled automatic

operation depends on the travel algorithm selected—in addition to the precision of the underlying axis position control. The behavior of the movement algorithm is very much a function of the interpolation method and the rounding algorithm.

The cartesian rounding algorithm developed by IITB reduces the path speed of a rounding point—if necessary—to a level where the programmed axis acceleration is always maintained when changing over to the new path segment. That is to say if the path radius is large the speed does not change, if it is smaller the speed is reduced correspondingly.

Together with non-contacting scanning of overlapping seams in welded sheet metal the process of sensor-assisted program generation was tested under near-realistic conditions. It turned out that the result of the reduction depends very little on the scan speed or the respective point density, but rather on the required tolerance. The process developed by IITB has considerable advantages over the customary manual programming both with regard to the time required for program generation and the quality of the movement program generated. In summary it can be said that the processes and programs for sensor-assisted control and program generation which were developed and implemented at IITB are able to improve considerably both the cost-effectiveness and efficiency of industrial robots.

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FRG's BMFT Funds 1988-1993 Manufacturing Technology Program

36980276a Duesseldorf HANDELSBLATT in German 18 Apr 88 p 5

[Text] Bonn, 16-17 Apr—A "Manufacturing Technology Program" with a term of 5 years, for which the Federal Ministry for Research and Technology (BMFT) is making available a total of DM 502 million, has now been submitted by Federal Research Minister Heinz Riesenhuber. It is supposed to help to create jobs for the 21st century.

With the submission of this proposal Riesenhuber stressed that the FRG, as an export-oriented high-wage country, must undertake large capital expenditures for the future if it is to maintain and strengthen its competitiveness and provide for future jobs. He said that a key task lies in introducing and constantly expanding a broadly based future-oriented innovation process in industrial manufacturing, which would include above all small and medium-sized businesses. In modern, flexible operating systems special attention must be devoted to the optimal interaction of people, technology, and organization. He said that the government can only give incentives for doing this. But industry and science are being called upon to undertake a future-oriented productivity offensive.

With the millions of marks made available for the next 5 years the assistance measures are to concentrate above all on two main fields: For one thing on "computer-integrated manufacturing" (CIM), and for another on new manufacturing technologies and on assembly work.

In the case of CIM, the information-technology interlinking of those operational divisions of a firm that are connected with manufacturing, three measures are foreseen.

1. "Broadly effective CIM technology transfer." According to Riesenhuber, in this area the practical knowledge and know-how of appropriate research institutes in the sector of CIM are to be converted at an accelerated pace into industrial applications. In this connection small and medium-sized businesses above all should be given the opportunity to speedily inform themselves about the possibilities of CIM; seminars are to serve the purpose of further education, and in 13 institutes the preparatory work for this has already begun, he said.

2. "Standardization in the CIM sector." In order to have a well-founded scientific basis for CIM standardization in the FRG, a special CIM working group is to be created in association with the Fraunhofer Society. This will have the task of participating in standardizations accompanying new developments and in the knowledgeable representation of the FRG in international projects. Riesenhuber indicated that a head office for CIM standardization is being established at the German Institute for Standardization.

3. "Indirect-specific assistance." Here, developmental work on the in-house application of CIM in businesses that are outfitting themselves with new manufacturing technologies is to be assisted, among other things.

As for the second main field of concentration, Riesenhuber stressed that new manufacturing technologies and machinery systems are needed in order to increase the efficiency of machining and manufacturing processes, in order to economically process new materials, or in order to be able to make new and better products by way of substantially greater precision in the work. He said that the development of such technologies is expensive and full of risks. Small and medium-sized businesses are frequently overtaxed in this area, he said. They are to be given the opportunity to develop jointly such future-oriented technical solutions in collaborative projects with other businesses and scientific institutes. Concerning the topic of assembly work Riesenhuber said that this is the sector with the greatest potential for modernization in industrial manufacturing. The competitiveness of European industry will be substantially governed by to what degree there is an accelerated future-oriented solving of assembly problems. Therefore within the framework of the Eureka program, cooperative projects in the area of "flexibly automated assembly systems" should be carried out, he said.

For the SPD, Josef Vosen made the criticism that with this manufacturing technology program Riesenhuber has neglected to put into practice his own statements on the "humanization of working life" and is now pinning his hopes solely on computer chips.

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LASERS, SENSORS, OPTICS

France's CNET Develops Red Band Laser

3698a226 Paris FTS—FRENCH TECHNOLOGY SURVEY in English Feb 88 p 4

[Text] An intense emission in the red band by doubling the emission line frequency of the YAG laser (Nd3+) to 1.32 micrometers has been achieved with an exceptionally high yield of some 50 percent with a non-lineair organic crystal under conditions yet to be further improved.

This device has been called the POM (3-methyl-4-nitropyridine-1-oxide, French Telecommunications Research Centre-CNET patent pending). The interaction length has been reduced to 7 mm. This 1.32 micron wavelength corresponds to that of Telecom semiconductor lasers. The resultant coherent emission in the red band is comprised of a train of pulses lasting several picoseconds and an average energy of several fractions of a mJ per pulse. This is a solid-state source laser which, apart from the POM, only uses conventional optic components making its use both simple and less costly. In addition to applications in fields linked with the emission of visible coherent light, this first experiment paves the way for future possibilities for amplification and emission parameters in the near infra-red band.

French Sensor Communication System in EUREKA

3698a227 Paris FTS—FRENCH TECHNOLOGY SURVEY in English Feb 88 p 5

[Article: "Factory Instrumentation Protocol Fieldbus"]

[Text] As part of the fieldbus program under EUREKA, CGEE Alsthom is already in the lead with the FIP bus, the first level in industrial LAN's. FIP stands for Factory Instrumentation Protocol. Fieldbus is a digital communication system designed to replace conventional cabling between sensors and control equipment, and between this same equipment and the actuators. It must cover the communication needs between the first level and the industrial process. All other LAN's, MAP [Manufacturing Automation Protocol] in particular, only cover the communication needs of the upper levels, that is, in the areas of supervision and management.

FIP periodically transmits photographs of the process to be monitored: its architecture provides priviledged access for periodic determinist traffic. However the maintenance and configuration needs make it necessary to have additional exchanges with fewer limitations in time: the mail services transit via the periodic off-peak traffic periods. FIP therefore provides for aperiodical traffic.

The data is transmitted by the transmitter to all the other users: FIP is a communications bus which allows for the connection of 40 stations with up to 100 subscribers per station. It has a capacity of 2,000 measurement data every 100 milliseconds, or 3,200 all-or-nothing data every ten milliseconds.

FIP is based on the ISO's open OSI architecture; however, its architecture is limited to layers 1 (physical layer), 2 (data link and suppport access management) and 7 (application).

French Fiber-Optic Production Facility Described

3698a228 Paris FTS—FRENCH TECHNOLOGY SURVEY in English Feb 88 p 7

[Article: "A Fiberoptic Production Centre for Extra-Telecommunications Applications"]

[Text] The Condensed Matter Physics Laboratory at the University of Nice in collaboration with the French Scientific Research Centre (CNRS) has opened a fiber optic production plant for extra-telecommunications applications: physical measurement sensors (temperature, pressure, position, etc.), lasers, light amplifiers, etc. This pilot plant which has been backed by several private and public organisations can produce fibres with widely varying forms: the dimensions and chemical composition of the fibre is reproduced exactly on a scale reduced by a factor of 500 from the initial preform obtained by MCVD [Modified Chemical Vapor Deposition]. This drawing operation of the silica preform is carried out on a special lathe equipped with a fusion furnace, a polymerisation furnace and a drum around which the fibre is wound at a speed which varies according to the diametre of the fibre being produced.

MICROELECTRONICS

IMEC, MIETEC Microelectronics R&D in Belgium

Details on IMEC Programs

3698a173 Brussels NOUVELLES DE LA SCIENCE ET DES TECHNOLOGIES in French Oct 87 pp 145-146

[Article by Roger J. Van Overstraeten, general director of IMEC: "Microelectronics R&D at IMEC"]

[Text]The Interuniversity Microelectronics Center (IMEC) was opened in Louvain in mid-1986. It accommodates about 250 scientific specialists of the superlab for conducting research into very large-scale integration (VLSI) chips which are 5 to 10 years ahead of industrial needs. IMEC has already been mentioned as an example.

INVOMEC, the IMEC program for industrial training in microelectronics, should be awarded a special medal. Due to this program, in which more than 20 European universities and many foreign companies are interested, 200 to 300 systems engineers graduate from the three Flemish universities and 13 Flemish industrial colleges each year. From the responses received, from foreign companies in particular, it appears that INVOMEC may be an additional asset that attracts new investors to Flanders.

IMEC has one training and three scientific divisions. It is interesting to give a summary of the activities of these divisions.

1. The VSDM division, responsible for studying the methods used to design VLSI systems, is run by Prof H. De Man. This division studies design methods and CAD tools with the goal of reducing the time needed to design integrated circuits. This research is thus done in the context of the evolution caused by the introduction of application-specific integrated circuits (ASIC). Integrated circuits, whose complexity continues to increase rapidly, now include millions of transistors per chip. The specificity of a circuit increases with its complexity. More powerful CAD methods, employing artificial intelligence techniques, are needed to reduce the time and therefore the costs of design. Even now there are many examples in which an ASIC circuit is a better solution than a microprocessor. Within a few years, a silicon solution will often be preferred to a software solution.

IMEC's policy consists of concentrating on a specific field which, however, covers a wide range of applications. The field chosen was digital signal processing, which offers many industrial applications: telecommunications, digitization of sound and picture, automation, speech and image processing, etc.

"Cathedral I," an operational compiler for designing bit-serial digital filters, has been developed. At the present time, research scientists are concentrating on "Cathedral II," which is being developed for the synthesis of synchronous multiprocessor integrated circuits. This system is based on the method of "meeting in the middle," which recommends complete separation between system and reusable silicon design. In this way, processors are synthesized by means of an expert system based on heuristic rules. The planned architecture consists of flexible modules. These modules are used in an environment of automatic and reusable module generation. The basic elements of the modules are created by the symbolic layout method, which has the advantage of being technology-independent.

At the same time, an expert system is being developed for verifying electrical characteristics during the silicon process design and for generating a functional, time-division model at the module or even the integrated circuit levels.

An initial prototype was developed which demonstrated that it is finally possible to entirely create an integrated circuit layout from a high-level algorithmic behavior specification within a minimum period of time. To achieve this, the principle of the three "i's" has been used: intelligence, interactivity, and iteration.

All this work is done in the framework of two ESPRIT [European Strategic Program for R&D in Information Technologies] projects (97 and 1058).

2. The ASP division deals with the study and development of advanced technologies for the manufacture of circuits and is headed by Prof G. Declerck. The use of microcircuits increases with the number of components on an integrated circuit. This development is caused by miniaturization (in industrial IC fabrication 1-micron features have now been reached and submicron sizes are under study in the laboratory), by better space utilization, and by an increase in the chips' outside dimensions. This results, of course, in an increasingly complex technology and calls for in-depth studies in lithography, dry etching, oxidation, ion implantation, surface diffusion, etc. IMEC studies all these technologies and develops complete manufacturing processes for transfer to industry.

This division studies CMOS technologies, mixed bipolar-CMOS technologies, and gallium arsenide (GaAs) and other III-V components technologies.

For instance, in 1985-1986 IMEC developed a new photosensitive resin in cooperation with Union Chimique Belge (UCB) which makes it possible to build 0.5-micron structures using simplified photolithography.

The same technological processes are used in the manufacture of several detectors; for electron and X-ray detection, detectors sensitive to the infrared range or in a portion of the visible spectrum. Several industrial companies use these detectors in their vision systems and in various types of equipment.

Some of the work is done within the framework of European programs, such as ESPRIT (Nos 554, 589, 962, 1043, 369), ESA (6 projects), and EUREKA (1 project).

3. The MAP division studies materials and integrated circuit packaging and is headed by Prof R. Mertens.

The study of materials is very important, not just to improve their performance, but also for developing three-dimensional integrated circuits (using silicon structures on an insulator) and for improving component behavior. A good example is a new bipolar transistor invented at IMEC which has an amorphous or microcrystalline emitter on a monocrystalline base. The

propagation delays along the interconnections will also be a constraint in future integrated circuits. This problem can be solved by optical interconnections which require GaAs on silicon.

This division also studies reliability problems and packaging techniques, which have not developed as rapidly as the integrated circuits themselves. Other studies cover solar cell fabrication using amorphous silicon, crystalline silicon, and GaAs as well as new sensors for detecting chemical products and various gases.

Research is carried out within the European cooperative framework of the ESPRIT (Nos 370, 519, 1051, 1056), Energie (4 projects), and EUREKA (1 project) programs.

Research into III-V components is done in cooperation with the University of Ghent (Prof P. Lagasse), which is focusing on integrated optical electronics. Some of the research is also conducted within the context of the RACE program (No 2023).

4. The INVOMEC division is planning a training program in VLSI circuit design headed by E. Bourdeaud-'hui. The development of ASIC's is slowed down mainly by a lack of integrated circuits designers. INVOMEC operates a computer network between IMEC and 16 institutes of higher education. Teachers and students are given access to the software. The circuits are then manufactured by IMEC or by industry. Courses are also organized for engineers who already work in industry. More than 50 custom circuits were manufactured in 1986.

Some of the research is also financed by FNRS [National Fund for Scientific Research], IRSIA [Institute to Stimulate Scientific Research in Industry and Agriculture], and the Service for Scientific Policy Planning in Belgium.

IMEC focuses university and industry efforts in the microelectronics field. It has a staff of 300 and cooperates with more than 70 industrial companies and 10 university groups. The IMEC initiative is still very young, but it is already possible to speak of scientific and industrial success.

Mietec R&D

3698a173 Brussels NOUVELLES DE LA SCIENCE ET DES TECHNOLOGIES in French Oct 87 pp 149-150

[Article by G. Schols, manager of development programs at Mietec: "R&D at Mietec"]

[Text] Since its founding in 1983 by Bell Telephone Mfg Co., Belgian subsidiary of Alcatel NV, and by GIMV, the Flanders Regional Investment Company, Mietec is recognized as one of the major European specialists in the market of application-specific integrated circuits (ASIC's).

The company's production unit and head office are located in Oudenaarde, while design and marketing activities are in Brussels.

Mietec, being the principal supplier of ASIC's for Alcatel's digital telecommunication systems, specifically targets the open market of mixed analog-digital applications, which includes areas such as telecommunications, automobile production, and industry in general.

In order to reach its goals, Mietec has developed two technologies:

1. a CMOS technology for high-density applications;
2. a BIMOS technology for high-voltage applications (up to 70 V), in which bipolar and CMOS components are combined on the same substrate.

Internal and National Research Programs

To be able to follow the rapid evolution in technologies, VLSI manufacturing techniques, and CAD and test generation technologies, Mietec invests large amounts in R&D every year. These investments amount to 9 percent of sales.

About 30 engineers of a staff of 300 take part in various R&D programs.

In this context, Mietec cooperates closely with university research centers and particularly with IMEC, the Interuniversity Microelectronics Center in Louvain.

At the national level (IRSIA), Mietec joins IMEC in the development of an advanced BIMOS technology as well as high-speed thermal techniques for future generations of CMOS technology. In the software field, Mietec and IMEC participate in the development of time-simulation and verification techniques for mixed analog-digital VLSI circuits.

Research on high-voltage components is done in cooperation with the University of Ghent. An automatic, hierarchical test generation program is also being developed in conjunction with the Free University of Brussels.

European Research Programs

The introduction of technology stimulation programs such as ESPRIT, RACE, BRITE [Basic Research in Industrial Technologies for Europe], etc. by the Commission of European Communities has opened new R&D prospects for Mietec in a European cooperative framework involving companies, universities, and research centers. The EEC assumes 50 percent of the costs of these R&D projects.

It is remarkable to see how much small- and medium-sized companies participate in these EEC programs. Basic research is very often reserved only for large

private and public research centers. Small- and medium-sized companies of fewer than 500 persons often do not have the time or the financial resources to enlarge the frontiers of technology. For the small EEC member states as well as for small- and medium-sized companies, these European research programs offer opportunities for innovation, information distribution, and application of technological developments.

In the framework of the ESPRIT program, Mietec is still conducting its program for the acquisition of high-tech tools required for the development of VLSI circuits and design methods for future CMOS and BIMOS technologies. Mietec often cooperates with IMEC in this European context.

Today Mietec is also engaged in programs to develop specialized plasma etching techniques and an automated ASIC line.

For the second phase of ESPRIT, Mietec cooperates in programs to develop a BIMOS technology for high-speed and high-density applications. The reliability of integrated circuits encapsulated in plastic packages will be one of the priority research fields.

In the framework of the RACE program, which is directed specifically at securing strategic telecommunications activities in Europe, Mietec chose to widen its experience in the field of dedicated high-reliability telecommunications circuits. Priority will be given to developments in the area of ISDN [integrated services digital network] and circuits for broadband telecommunications.

In addition to these EC Commission programs, the EUREKA program was established in Europe as early as 1985. It should complement the initiatives of the EEC. Whereas EEC programs mainly focus on precompetitive R&D, called "technology push," the EUREKA program concentrates more on the market aspect, on "market pull." The EUREKA program offers fewer possibilities to the small member states, small- and medium-sized companies, and Mietec. In spite of its market approach, these can easily be kept out of EUREKA cooperation agreements. Moreover, few universities and research institutes participate in this program, mainly because of its market orientation. However, it is precisely these centers that handle information distribution in the EEC programs.

For Mietec, participation in the ESPRIT and RACE programs is essential to keep up with the rapid changes in ASIC development, which is its basic activity.

25053

SCIENCE & TECHNOLOGY POLICY

Japanese Investment in EC Nuclear R&D

3698a206 Brussels EC PRESS RELEASE in English No IP(88) 130, 9 Mar 88 p 1

[Article: "Joint Research Centre Gets 2 Million ECU Contract From Japan"]

[Text] The Commission's Joint Research Centre (JRC) and Japan's Central Research Institute of the Electric Power Industry (CRIEPI) have signed a contract worth 2 million ECU under which the Karlsruhe Establishment of the JRC will carry out a study on the transmutation of long-lived radioactive nuclides (recovered from high-level radioactive nuclear waste) into short-lived ones.

This research project will last 4 years, and will begin with an examination of the preparation and properties of fast breeder reactor fuels which contain neptunium and americium, the so-called "minor actinides", as major components.

CRIEPI considers this technique as a promising option to reduce the half-life of waste from its nuclear power plants by orders of magnitude. JRC Karlsruhe has considerable expertise in carrying out research in this field, and has been engaged in transmutation studies for several years.

Background

The nuclides under consideration are radioactive elements which do not occur naturally, but are formed in nuclear reactors as a product of the nuclear reaction. The lifespan of these nuclides (described in terms of their "half-life") can vary from several 100,000 years down to fractions of a second. Neptunium and americium have a very long half-life, and their presence in spent nuclear fuel poses a major problem in subsequent radioactive waste disposal.

However, by bombarding these nuclides with neutrons, it is possible to transform them into other nuclides with much shorter half-lives. This process is known as transmutation. Such a method could facilitate considerably the safe disposal of this type of radioactive waste.

April 1988 Status of EC Research Projects

ESPRIT II Formally Launched

3698a233 Brussels EC PRESS RELEASE in English No IP(88) 206, 11 Apr 88 pp 1-2

[Article: "The Second Phase of ESPRIT Is Launched"]

[Text] The Council of Ministers of the European Community gave today the formal go-ahead to ESPRIT II, the second phase of the ESPRIT Community Research and Development Programme in Information Technology. ESPRIT is the flagship of the Community's research

programmes. With its total of 4.7 billion ECU funding over the period 1984-1993, of which the Community bears 50 percent, ESPRIT is the largest single R&D programme the Community has ever undertaken.

The first phase of ESPRIT, ESPRIT I, brought together nearly 3,000 researchers and engineers, from over 400 separate organisations in all the Member States, working in over 220 projects. ESPRIT II will involve some 500 researchers and at its peak will represent about 30 percent of all European precompetitive R&D in information technology.

The success of ESPRIT I can be seen in the industrial impact of the projects, a majority of which have already produced results of substantial industrial significance.

Thus, for example, the new international Standard on Office Document Architecture (ISO 8613) was first prepared in an ESPRIT project, then accepted by the European Computer Manufacturers' Association, and has now been adopted as an international standard by the International Standards Organisation (ISO)—the first full ISO standard to have come out of ESPRIT.

An example of a major technological achievement is the T800 floating point transputer, the most powerful chip on the market today, developed by the ESPRIT Supernode project. This project is now going on to develop a very high speed computer based on this chip, a "minisupercomputer," which will offer a price/performance ratio superior to anything available today.

For the second phase of ESPRIT, the Commission intends to consolidate the success already achieved. The objectives and the basic rules of the programme remain unchanged. The principle of transnational, industrially oriented, collaboration between independent partners also remains unaltered, as does the 50 percent coverage of project costs by the Community budget. The sectors for support have been adapted to the rapid pace of technological development and consolidated in three sectors: microelectronics, information processing systems, and IT application technologies. New emphasis is being placed on computer integrated manufacturing (CIM) and application specific integrated circuits (ASICs).

A new practical element introduced into the programme is the possibility of participation by EFTA organisations. Also new is the inclusion of a series of actions in key areas of basic research in IT, which aims at complementing the industrially-oriented programme.

ESPRIT II falls under the Framework Programme for Community Research and Technological Development, the adoption of which has eased the path for the implementation of ESPRIT II. To enable ESPRIT II to build rapidly on the success of ESPRIT I, the European Commission made a public call for ESPRIT proposals on December 29, shortly after the Council of Ministers came to its common position on ESPRIT II. This call for proposals does not close until tomorrow, 12th April; but preliminary indications suggest a response from industry even more enthusiastic than earlier calls.

The Commission will finish its evaluation of the proposals received by the end of May, and the first projects can be expected to start in late summer 1988.

DRIVE Program Accelerated

3698a232 Brussels EC PRESS RELEASE in English No IP(88) 205, 11 Apr 88 pp 1-2

[Article: "Common Position of the Council on Drive Programme"]

[Text] The Council of Ministers today reached a common position on giving approval to DRIVE, a 120 million ECU, 3 year programme of collaborative research and development which seeks to alleviate some of the present problems in road transportation through the application of advanced information technology and telecommunications. DRIVE, which stands for Dedicated Road Infrastructure for Vehicle Safety in Europe, aims not only to improve road safety but also to reduce wasted time and fuel through the improvement of transport efficiency, and thereby reduce vehicle emissions and noise pollution.

The speed with which DRIVE has gained approval is clear evidence of the importance which the Community attaches to solving these problems. DRIVE has its origins in 1986, the European Year of Road Safety, when the European Parliament supported the inclusion of road transport as one of the areas to be addressed by the Community's Framework R&D programme. After initial studies, the Commission made proposals for a programme of work on 24 July 1987 which was followed by their adoption by the Parliament on 11 March this year.

The scale of the problems which DRIVE addresses is given by the following statistics:

—Every year in the Community 55,000 people are killed on the roads, 1.7 million are injured and 150,000 permanently handicapped;

—The financial cost of this is estimated to be 3 billion ECU per year; the social cost in human misery and suffering cannot be measured;

—The wasted time and fuel due to congestion and poor routing is estimated to cost the Community around 20 billion ECU per year;

—Environmental pollution is estimated to cost between 5 and 10 billion ECU per year.

Without concerted action these problems will get worse, as vehicle performance continues to increase in relation to its near-static capacity. Existing solutions such as

traffic management schemes, civil engineering improvement, engine management technology and Community Directives on vehicle standards do help, but they do not go far enough; a common, European road transport environment where drivers are better informed and "intelligent" vehicles communicate with the road infrasturcture itself is seen as a major advance in improving the situation.

DRIVE therefore seeks to create the conditions for this integrated road transport environment through pre-competitive and collaborative R&D in the field of information technology and telecommunications applied to road transport. It will bring together research institutions, industry and road transportation authorities and will operate under the rules of the Community's Framework Research Programme, with 50 percent of the costs being funded by the Community and 50 percent by industry. DRIVE will be complementary to other European initiatives in the domain, particularly those under EUREKA and COST.

The areas that DRIVE will be addressing include systems for:

- Speed and distance-keeping
- Hazard warning
- Monitoring the alertness of drivers
- Protection of vulnerable road users (pedestrians, cyclists, etc.)
- Recording accident data through "black box" technology
- Providing information to drivers
- Route guidance and planning
- Vehicle location
- Regulating traffic flow by intelligent signalling systems
- Demand management, including automatic toll payment
- Etc.

DRIVE aims to achieve the following:

—To identify the best choice of systems and the best strategy for their implementation;

—To specify performance and compatibility standards which will enable industry to develop the necessary equipment and systems;

—To provide Directives and guidelines to which industrial products and "intelligent" European road transport infrastructures should conform;

—To enable the design, and if necessary, the implementation of pilot schemes for the performance of equipment and systems.

The importance of harmonised European standards must be stressed, for without them difficulties would be put in the way of international road travel and non-tariff barriers for industry. Common standards will result in a unified European market for RTI products which will bring down costs of mass production and provide a large home market which will improve the world competitiveness of European industry.

It is expected that the programme will commence in July with a call for participation and the first projects will start in early 1989.

Continuation of Major Programs

3698a231 Brussels EC PRESS RELEASE in English No IP(88) 203, 11 Apr 88 pp 1-2

[Article: "Council Reaches Common Position on Three Key Research Programmes"]

[Text] The Council of Ministers today reached a "common position" on the continuation of three key research programmes, which will be implemented as part of the Community's 5-year Framework Programme for Research and Technological Development (1987-1991). These programmes will now be examined by the European Parliament before returning to the Council for final adoption. Each of these programmes has already made a significant contribution to collaborative research in the Community, and has produced scientific results of considerable value.

1. Stimulation of the International Cooperation and Interchange Needed by European Research Scientists (1988-1992)

Known by its French acronym SCIENCE, this is a continuation of the "Stimulation Programme". It aims to increase the scientific and technical potential of the Community as a whole by stepping up cooperation and exchanges between scientists on high quality research projects in all fields of the exact and natural sciences (especially those which are multidisciplinary). This programme has no equivalent in the US or Japan.

The programme will take the form of a range of measures to aid the training and mobility of researchers, communication and exchanges of information among scientists, and the development of R&D cooperation involving all Member States. These measures will include bursaries, research grants, training courses, laboratory twinnings, operations contracts, and contextual measures to encourage the trans-frontier mobility of research scientists. The funds estimated as necessary for this programme amount to 167 million ECU.

2. Biotechnology Action Programme (1985-1989)

This is a revision of the current research programme, with a request for supplementary funding (20 million ECU) to carry out a number of specific objectives:

- to increase the training of highly-specialised researchers
- to integrate Spanish and Portuguese laboratories into the programme

- to extend the use of bio-informatics (genome sequencing, computer- aided design of proteins etc.)
- to step up research into risk-assessment
- to carry out feasibility studies for the next Community biotechnology programme.

The aim of this programme is to improve the capacity of Member States to develop biotechnologies relevant to the preparation of improved agricultural and bio-industrial products. It includes enzyme engineering, genetic engineering, "in vitro" testing of molecules of toxicity, cell technology and the collection of biotic materials. It is also intended to contribute to the establishment of new methods for the evaluation of biohazards and to the development of policies for the promotion of biotechnology in the Community.

3. Applied Metrology and Chemical Analyses (1988-1992)

This is the research programme carried out by the Community Bureau of Reference (BCR), providing scientific support for the harmonisation of common written standards where technical measurements are required. The programme is particularly important for the work needed to complete the Community's internal market by the end of 1992. The funding required is 59.2 million ECU.

The BCR brings together laboratories in all Member States to improve measurement for which there are difficulties or disagreements. Activities included inter-laboratory comparisons, collaborative measurement programmes, improvement of analysis and measurement methods, improvement of high-precision instruments, the preparation and certification of standard reference materials, scholarships and scientific exchanges. Priority areas include:

- Applied metrology (physical measurements for trade and industry, including electrical, optical and flow measurements, temperatures, acoustics, ultrasonics and the properties of materials)
- analyses for food and agricultural produce
- analyses related to the environment
- analyses related to health
- analyses of metals.

Funding for Steel Research

3698a229 Brussels EC PRESS RELEASE in English No IP(88) 161, 17 Mar 88 pp 1-2

[Article: "30 Million ECU for ECSC Research"]

[Text] The Commission has decided to commit 30 million ECU to finance 82 technical research projects in the steel sector and seven pilot/demonstration projects under Article 55(2)(c) of the ECSC [European Coal and Steel Community] Treaty. The ECSC Consultative Committee must now be consulted and the assent of the Council sought in order to finalize the funding of these projects.

The Commission's commitment represents the whole of the 1988 budget allocation for technical research: 21,064,000 ECU will go on 82 research projects and 8,211,050 ECU on the seven pilot/demonstration projects, while the remainder (724,750 ECU) will cover ancillary costs and pay for the dissemination of the knowledge gained from the two series of projects.

Eighteen other research projects costing a total 7,326,000 ECU are being held in reserve and will be financed later.

The projects to be financed by the Commission comply with the ECSC objectives for steel research. Their main purpose is to make steel production and processing more cost-effective and to ensure that the product is of a more uniformly high quality. They also aim to promote steel consumption both within the Community and on export markets by developing improved types of steel and new uses for steel in products which are technically and economically more advanced than those of the Community's competitors.

Finally, these projects take account of other research which receives financial aid for the ECSC.

All the chosen projects have been approved—the research projects by the Iron and Steel Technical Research Committee (TRC) and the pilot/demonstration projects by the Iron and Steel Technical Development Committee (TDC)—for receiving financial aid from the ECSC.

The financing has been allocated among the research areas as follows:

- Ore reduction	2,174,100 ECU
- Steelmaking	4,746,000
- Transformation	3,488,400
- Measurements and analyses	3,299,100
- Properties and service performance	7,116,600
- Miscellaneous	240,000

The allocation for the pilot/demonstration projects is as follows:

- Ore reduction—waste processing	3,148,750 ECU
- Continuous casting—Thin products	1,671,850
- Rolling of flat products—surface inspection	2,146,650
Product processing	1,243,800

EC Initiatives To Create Investment Adopted

3698a207 Brussels EC INFORMATION MEMO in English No P-25, 16 Mar 88 pp 1-3

[Article: "Promotion and Financing of Technological and Industrial Cooperation"; Communication by the Commission to the Council and the European Parliament (COM(88) 114)]

[Text] The Commission has just adopted a communication on the promotion and financing of technological and industrial cooperation following suit to a communication submitted in September 1986, in which the Commission made the point that the financing of high technology and industrial renovation would be one of the priorities of its financial engineering activity. The new communication takes into account the lessons drawn by the Commission from in-depth contacts with entrepreneurs and financial operators in the Community.

First, the document analyses the difficulties facing companies and their financiers that undertake technological and industrial cooperation projects. These problems stem, in essence, from the fiscal, legal and financial environment in which operators carry out their activities.

Second, it puts forward a number of proposals aimed at facilitating the transition to the industrial application stage of cooperative ventures that already exist at pre-competitive level, in particular through Community programmes in the field of technological R&D. To this end, the communication announces a timetable for a series of concrete Commission initiatives.

FINANCING REQUIREMENTS

The financial needs of transnational projects increased substantially following the expansion of technological R&D initiatives launched by the Commission in the context of the 1987-1991 framework programme and its specific new programmes. Overall, the transnational projects in these programmes account for a total of some 11 billion ECU. In a wider context, the EUREKA initiative, which brings together 19 European countries and the Commission, has resulted in 165 projects of a total cost of close to 4 billion ECU.

These programmes form the basis of an important and growing number of transnational projects representing the first industrial follow-up to pre-competitive research work. However, before reaching the stage of industrial application, the follow-up projects have to pass through a "grey" area between the stages of pure research and marketing. As long as they remain within this area, their prospective returns, although significant, are deferred and subject to considerable risk.

It is not yet possible to put exact figures on the private financing requirements to which these transnational initiatives will give rise. However, an estimation made by European bankers allows to appreciate the amounts involved. According to this estimation, 12 percent of the EUREKA projects, costing some 5 billion ECU, were probably suitable for private financing. Other EUREKA projects, amounting to about 2 billion ECU, are still too far upstream to interest private operators but will provide investors with investment opportunities as and when they are developed.

DIFFICULTIES

Difficulties and shortcomings stemming from the tax, legal and financial environment were highlighted in the Commission's contacts with industrial and financial operators. In the light of these views, the communication pays special attention to the following problems.

Financing Difficulties

Conventional methods of financing can seldom satisfy the needs of transnational technological projects. This mismatch is particularly noticeable when the promoters are newly established or budding SMEs. The reasons for this include the following:

—the self-financing capacity of such firms is inadequate;

—the intangible nature of their initial assets is unlikely to provide an acceptable guarantee. The fact that, for several years to come, repayment of the financial support needed will probably absorb all the anticipated profits means that the granting of conventional loans is fraught with risk;

—traditional project-financing techniques call for a lower level of risk than that associated with the technological projects in question.

Under these conditions, the provision of equity capital should be a suitable answer. However, the transnational nature of the project and the differences in the tax environment and administrative rules applying to each of the promoters not only make for higher costs but also add to financing difficulties. Moreover, venture-capital operators are still reluctant to fund such projects largely because they are relatively remote from the marketing stage.

Diversity of Tax Regime

The national tax environment within which the partners in a transnational technological project have to operate differ widely and in some aspects even give rise to distortions.

In some member states for instance, tax favours granted to investors apply exclusively to portfolio income from domestic investments. In some cases, the activities of

venture-capital companies as intermediaries between those providing finance and the project promoters do not add to the tax burden, and this means avoiding any form of double taxation. In other cases, however, their income is subject to general tax regulations applicable to any company without exception.

Lack of Proper Legal Framework for Cooperation

Efforts undertaken in the field of European company law have not yet given rise to a specific legal framework to facilitate the financing of a transnational project. The European Economic Interest Grouping (EEIG), which is scheduled to become effective on 1 July 1989, offers no solution to the problem of financing, since it will not be able to draw on the savings of the public.

ACTION PROGRAMME

In identifying the measures to be taken by the Community, due regard has been given to the needs made known by operators involved in transnational technological and industrial cooperation. In order to let markets fully play their role, the contribution of the Community aims at establishing an appropriate framework. In addition to initiatives launched earlier, therefore, the Commission proposes a new set of actions along three lines.

Promoting the Establishment of Appropriate Investment Mechanisms

The Commission will strengthen its efforts to help the creation in 1988 by financial intermediaries of new investment tools specializing in the financing of transnational technological projects. The prototype for a financial set-up the Commission would like to see mushroom is a private institution, at this stage called EUROTECH CAPITAL, managed solely in accordance with market requirements. The objective of EUROTECH CAPITAL would be to provide equity capital to these projects and after a few years realize gains on its holdings. From a legal viewpoint, EUROTECH CAPITAL could be set up either as a fund or as an investment company.

Promoting Interaction Between Scientific, Industrial and Financial Operators

In 1988, the Commission will establish a databank to provide operators with practical opportunities to secure private financing for projects, these opportunities being opened up by the implementation of Community technological research and development programmes.

Improving the Tax, Legal, and Financial Environment

The Commission will be taking steps in the first half of 1988 with a view to getting discussion moving again in the Council on the proposal for a Regulation on the European Company.

Moreover, in order to make it easier for the Community authorities to approve the 1975 proposal for a Directive on the harmonization of systems of company taxation, the Commission will in 1988 present a proposal for harmonizing the corporation tax base and, where appropriate, once it has received Parliament's opinion, a number of amendments updating the 1975 proposal.

The Commission will also lay before the Council proposals dealing with the following four matters:

—amendments to the fourth and seventh company law Directives that will allow firms to draw up their annual accounts either in national currency or in ECU (third quarter of 1988);
—application to venture-capital companies of the principle of tax transparency (beginning of 1989);
—provisions to facilitate the issue, payment and quotation of shares in ECU;
—a recommendation to facilitate the development of second-tier markets.

Industry Sponsors Pan-European 'PACE' Training Program

36090300c Paris ELECTRONIQUE ACTUALITES in French 6 May 88 p 2

[Article: "Continuing 'High-Tech' Training; The European PACE Program Will Be Based in Paris"]

[Text] At the close of a severe competition, in particular with Amsterdam, Paris was finally chosen as the permanent headquarters of PACE, the new European continuing "high-tech" training program.

In a communique, the Thomson group stressed the leading part it played in selecting Paris as headquarters for the satellite system that will broadcast lectures and interactive seminars to engineers and scientists throughout West Europe.

Subsidized by the EEC, PACE, as is known, is essentially an initiative of European manufacturers. In addition to Thomson, the program partners include British Telecom, HP Europe, IBM-Europe, Philips, Bull, Digital Europe, etc. The program managing committee is chaired by Mr Hubert Curien.

PACE will broadcast several hundred hours of lectures per year—in particular on microelectronics, expert systems, software engineering, telecommunications, advanced industrial engineering, technology management—to several receiving sites, such as Thomson, where there are already four.

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ADVANCED MATERIALS

New GDR Polymer Paste Finds Application in Circuit Design

23020015 East Berlin TECHNISCHE GEMEINSCHAFT in German No 5, 1988 p 12

[Text] A polymer conducting paste, based upon copper, has been jointly developed by the VEB Electronic Components, Dorfhain, and the Central Institute for Solid State Physics and Materials Research, Dresden. The paste is suitable for screen printing of printed circuits and connection contacts on laminated paper substrates. Such pastes are used in thick-film technology for the manufacture of hybrid integrated circuits. For the new product, specified bonding agents were used so that it can be worked upon various base materials. Thermal recrystallization at up to 200°C, without protective gas, does not affect the properties of the paste. With it, a high conductivity can be achieved which remains stable for a long time. Noble metals used in these and similar cases, up to now, can be replaced [by this paste].

COMPUTERS

Polish CAD Software Packages for Machine Tool Design

26020013a Warsaw PRZEGLAD MECHANICZNY in Polish No 23, 1987 pp 25-29

[Article by Dr Stefan Berczynski, deputy director, of the Institute of Mechanics Technology at the Szczecin Polyclinic, and Engineer Slawomir Zaboklicki, director of the Computer Technology Laboratory at that institute: "Computer Aided Design of Machine Tools: Characteristics of Six Software Packages Comprising the Entire CAD Process"]

[Text] The work on computer-aided design of machine tools conducted under CPBR [Central R&D Program] 7.5 is a continuation of the research implemented during 1976-1985 under Key Program 05.1. During that period were developed many original methods for the simulation and evaluation of the rigidity, plus dynamic and thermal properties of machine-tool assemblies, along with the related software. The principal purpose of the development of that software was to evaluate the adequacy and accuracy of the simulation techniques adopted. Thus, that software was more in the nature of an aid to research than an aid to design work, chiefly owing to the failure to adapt it to the scope of knowledge, style of work, and habits of designers.

A major obstacle to the spread of software has been the diversity and mutual incompatibility of the computers on which it was developed. Hence also the application of software consisted in the calculations of newly designed machine tools directly by the authors of the software. The results, compared with the results of the studies of experimental prototypes, showed that in many cases achieving a satisfactory accuracy of results requires complementing the adopted models of machine-tool components with credible models of fixed and moving linkages. These calculations also showed that unsatisfactory evaluations of the characteristics of a machine tool are often due to the absence of any analyses or calculations for the initial stages of the design process—stages during which the basic elements of the design are developed, which again determine its utilitarian characteristics.

These conclusions, reinforced as they are by the results of polls conducted among designers working at many plants of the machine-tool industry, warrant stating that:

- assuring a high precision, productivity, and durability of the machine tools to be operated in the ESP requires that CAD (computer-aided design) be also extended to initial design stages
- the conceptual (selection of geometric-motion structure) and the preliminary (development of design elements) stages;
- success in introducing CAD techniques into actual design work will be decided by, on the one hand, the credibility of the proposed computational techniques and, on the other, the adaptation of CAD systems to the working conditions and style of work of designers and their scope of knowledge. Another decisive factor is the complexity and internal integration of these systems (construed as the coverage, in the broadest sense, of the entire design process by a system that automates both the calculations and the flow of design information).

Bearing this in mind and allowing for the actual possibilities of the teams engaging in this research, one of the premises for drafting Research Program CPBR 7.5 was to develop and introduce in design offices at selected machine tool factories systems for computing machine-tool elements and components. These systems were to comprise the entire design process. Another premise was that these systems were to be integrated into a single coherent CAD system. Here a CAD system is construed as not only a tool for accelerating routine calculations or drafting but mainly as a system assuring the storage, processing, and transmission of design information at every stage of the design process and enabling designers to perform directly not only routine calculations but also complex verifying calculations.

The development of a thus construed CAD system will require, independently of the development of a computational program, many studies of the substantive and computer-oriented principles of the program. The related work will focus on:

- the creation of a data bank with data on compression-dissipation parameters and fixed and moving linkages present in machine tools, as based on computations related to the adopted models;
- the development of system structure and software for

the creation and operation of the system (problem-oriented databases, modules for graphic data input, program editors for design results, etc.);
- the development of ways and means of guidance of the system's operation by users;
- the introduction of means of integrating the various subsystems into a single coherent CAD system.

Bearing in mind that the parameters of the computer equipment acceptable under existing conditions define the development framework of the entire CAD system, IBM PC type microcomputers were adopted as the basic computers, on also assuming that in the future it will be necessary to transfer the complex calculations to computers with greater computational power. Until that time the systems will be implemented and introduced on 16-bit microcomputers.

The whole of the problems of machine-tool CAD was divided in the CPBR 7.5 Program into six systems or packages of software corresponding to successive stages in designing a machine tool and in the scope of calculations or to implementor; systems that are mutually coherent owing to the use of common basic and auxiliary software tools.

The CAD System for Machine Tool Design

The work will include the creation of a CAD system for machine tool design as well as of the related software tools. It will consist chiefly in the development of professional software for:

- establishing and operating problem-oriented design databases;
- graphic data input and graphic display of the results of routine and verifying calculations;
- interactive guidance of design progress;
- accelerating the development of applications software by isolating and refining modules that are common to the system as a whole (data input, data revisions, etc.).

The principal software tool used will be the GEM System (Digital Research company) which assures the development of applications software at the highest level possible for the related class of hardware. It contains the following subroutines: graphics (consonant with GKS), user-system interaction procedures (windows, icons, pulldown menus), and interaction with the operating system.

As for basic software (chiefly databases and computer-aided design and drafting) so far nothing meeting the requirements posed to a CAD system could be selected. Hence, it was decided to develop from the scratch a system structure (Figure 1) based on the experience gained while operating the previously developed SAUNO system for analyzing geometric-motion structures of machine tools.

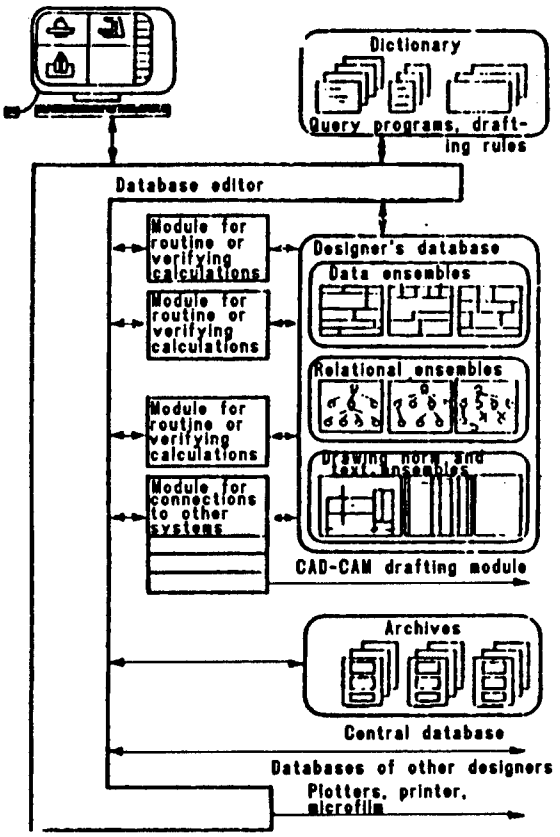

Figure 1. Structure of the CAD System for Machine Tool Design

The core of this system will be a hierarchic dictionary-type database serving to store design information in the form of query-program answers, drawings, and texts, in segments whose size and structure are defined by the programmer or designer. The mutual relations among the database segments are determined directly by the designer, who also fills the segment with information. The possibility of individualized determination of many mutual relations for the same or partially overlapping groups of data segments will be assured.

The internal structure of a segment is defined by the **system dictionary** which specifies, e.g., the forms of query programs, descriptions of these programs, and attributes of graphic forms of data presentation. The module for direct interaction between the designer and the system (termed the Database Editor) will, when utilizing the information information contained in the dictionary, enable the designer to create a design by introducing its description into the database, reviewing and correcting data and activating routine and verifying calculations. It is assumed that the final form of the Editor will be elaborated in four stages.

Stage 1. A prototype version of the Editor serving to input data by defining the structure of the base and answering queries on the monitor.

Stage 2. First application version of the Editor, based on the graphic creation of designs from basic building blocks.

Stage 3. Second application version of the Editor, based on the graphic creation of intricate designs.

Stage 4. Final version of the Editor, allowing for the experience gained while using the previous versions.

The database established with the aid of the Editor will be accessible to routine and verifying computational modules through the mediation of a library of especially developed database-access procedures. Independently of this, the database and the Editor will serve as a design data bank that can be administered directly by the designer, who will be enabled to store information not used at the moment. The base structure described can be input as a "substratum" in a form acceptable to design-and-drafting software with the object of conversion to technical drawings. After the system is provided with a multiple-format plotter, it will also be possible to print out the substrata directly on paper. It will also be possible to link the database of the CAD system to other computational systems once the data conversion operators are determined.

It is assumed that ways of utilizing the CAD system in design offices will be developed with the participation of designers who shall thus develop, among other things, an operationally most convenient technique for the collection and exchange of design information on using the software tools proposed in this work. They shall also serve on a continuing basis as consultants and evaluators of proposed solutions.

Acting on these assumptions, during the first stage were developed procedures for access to the database from the level of the system's computational modules; also developed was a prototype version of the Database Editor. However, in view of the importance of computer graphics to the problems of CAD as a whole, a program for a graphic presentation of the geometrical data contained in the database was also developed during that first stage. Once this work is completed as scheduled at the end of 1987, a CAD-system version suited for experimental operation at research institutions and in interested plants and factories will be obtained.

The libraries being developed during this first stage:
—the GEM system (graphics and guidance),
—procedures for access to database,
—and elementary procedures of three-dimensional graphics
will represent the **set of software tools** for the CAD system.

Along with the work on the software tools for the CAD system, work is under way on **applications software**, which comprises problems of analyzing machine tool designs durign the conceptual (analysis of geometric-motion structures) and preliminary (design calculations of drive systems) stages of the design process.

The geometric-motion structure of a machine tool is construed as the spatial configuration of moving elements of the machine relative to the object being machined, the machining implement, and the stationary main housing. The cutting and shaping movements needed to carry out a particular machining operation can be accomplished by means of various designs. The crucial problem at the conceptual stage is the selection of the optimal design, because this determines the useful characteristics of the machine tool.

The optimal design will be selected in two stages. During the **first stage**, out of a complete set of designs corresponding to specified conditions of machining, the designer will select only those meeting the so-called structural requirements of selection and allowing for various factors ensuing from the technology, operation, ergonomics, and organization of the production process. Taking into account the design requirements for the selection, the designer will derive a small subset of designs from among which he finds the optimal design.

During the **second stage** a comparative analysis of the subset of the selected designs will be conducted. Here the main criterion will be the technological rigidity of the loadbearing system of the machine tool, as determined at various points in the operating space. The computational algorithms will be based on the solids-modeling method, complemented with the possibility of simulating machine-tool guide joints, with allowance for such factors as the onesidedness of the work of contacting surfaces, clamps, errors in shape of surface, and nonlinearities of compressive characteristics.

As a result, the designer will derive not only the values of technological rigidity at specified points in the operating space but also maximum pressures and friction stresses on the surfaces of guides or crossways of the analyzed structure. To assist in designing drive systems, a package of modules will be developed for calculations of:

- technological loads on machine-tool spindles;
- strength and rigidity of the standard components and assemblies of drive systems, including gear trains, belt transmissions, arbors, bearing beds, spindle assemblies, and servodrives.

This system is being developed by the Institute of Mechanics Technology, Szczecin Polytechnic.

Software Package for Routine Machine-Tool Design Calculations on 16-Bit Computers

The principal purpose of this project is to develop as soon as possible a set of software programs for IBM PC microcomputers with the object of handling routine design calculations, and thereupon to introduce them

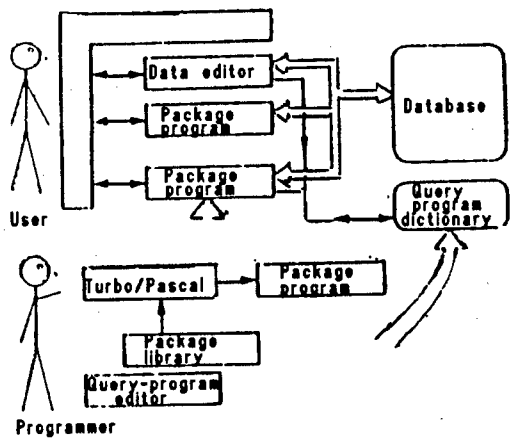

Figure 2. Structure of Package for Routine Design Calculations

successively at design offices. Since it was possible to consider developing such a package from the scratch, as it were, owing to the absence of such software for the IBM PC, the integration of existing and newly developed computational techniques into a single coherent package was attempted. To accomplish this integration, priority was given to developing:

- a uniform and user-convenient technique for data transfer among programs (among other things, for transfer of the computational results of one program as input data for other programs);
- a uniform procedure for booting and revising data and directing the course of the calculations.

Since the software package is being developed gradually and in the next few years the greatest possible number of diverse programs is going to be incorporated in it, it was necessary to develop a structure and technology of program development that would assure a simple incorporation of new programs without having to restructure the existing ones. The structure of the software package is shown in Figure 2.

The principal elements integrating the package's programs are the Database and the Control Program. All programs communicate with each other via the Database, whose data are grouped into segments. The form of a Database segment (as defined by so-called query programs) is determined by the developers of application software (they may utilize previously formed segments). Each segment has its own identifier consisting of the name of the questionnaire type, conferred on it by the programmer, and the name given to it by the user at the moment of accessing the Database. The query programs may be complemented with corresponding auxiliary programs that contain, e.g., drawings elucidating the significance of particular data.

The Database Editor serves to input or change existing data. With its aid, the user can examine the existing databases and change their structure as well as the data contained in their discrete segments. The Editor is also equipped with a Help function enabling the user to ask the program for assistance and for explanations of particular commands.

The role of the package-governing program is exercised by the Control Program, which enables the user to activate the Database Editor and all application software and to review catalogs of software, databases, and questionnaire dictionaries. The Control Program also serves to format the information presented on the monitor inside the so-called windows or parts of the monitor isolated by the package's programs. The windows may be superposed on one another or realigned to cover or uncover the monitor or other windows. The contents of the windows and the windows themselves are stored in the memory controlled by the user. He may make some windows invisible or record their contents on disks in order to recreate them in the future. Window operations are performed by pressing the appropriate function keys on the keyboard. An user who desires to perform a calculation has to verify whether corresponding data are contained in a particular database segment and, as the need arises, complement them. Upon deriving the results of the calculations he can record them in the database or print them out, or store them in the form of a window, e.g., for comparison with the computational results for the next variant.

Many tools for programmers have been developed in order to shorten the time of the development and introduction of software packages. They include the Turbo-Pascal graphics library, procedures for access to databases, and a text editor for query programs enabling the programmer to define the names and structures of segments.

The thematic scope of applications software is broad, comprising:

- programs for analyzing technological loads on spindles and loadbearing systems;
- programs for aiding in the design of the standard drive elements and assemblies of machine tools, on taking into account the strength and rigidity requirements for the gear trains, belt transmissions, arbors, spindles, bearing beds, servodrives, etc.;
- programs for analyzing the operating properties of machine tools, including power loss in elements of the drive train, pressure and displacement diagrams in guide joints, and the static and dynamic properties of spindles;
- programs for specialized calculations of the components and elements of grinding machines and heavy machine tools.

In addition, the package will be expanded to include catalogs of manufacturer-offered components and assemblies and a card-file index containing iconic information on the static and dynamic properties of machine-tool assemblies.

The software tools for the package were developed at the Institute of Mechanics Technology, Szczecin Polytechnic, which also is the coordinator of the project and one of the main implementers of the applications software.

Software Package for Routine Design Calculations on 8-Bit Microcomputers

This package was developed on ZX-Spectrum microcomputers, owing at first to the accessibility of these computers and later to an agreement with the plants introducing this software. The package comprises CAD programs for the most common components and elements of machine tools as well as programs facilitating the analysis of their principal properties in the design stage. These programs can be divided into the following thematic groups:

Programs for Analyzing External Loads on Machine-tool Components and Assemblies:

- Tosil, for calculating the cutting forces during lathe
- Frezw, for calculating the cutting forces during milling;
- Walobc, for calculating the loads on drive components.

CAD Programs for Machine-tool Assemblies and Components, with Allowance for Strength and Rigidity Requirements:

- Kopas, for designing V-belt transmissions;
- Kowal, for designing cylindrical gear trains;
- Kosto, for designing bevel gear trains;
- Wdwew, for designing the basic geometry of the spindle;
- Walgco, for designing double-support shafts;
- Serwo, for designing servodrives for feed motion;
- Ospl, for calculating the rigidity of bearing supports.

Programs for Analyzing the Properties of Machine-tool Assemblies:

- Rbeso, for computing power loss in links of the drive chain;
- Wrzec, a program for determining the static properties of spindles;
- Cpwow, for computing the frequencies and forms of the transverse free vibrations of spindles;
- Prowa, for computing the forces, pressures, and displacements in guide joints.

These programs were developed by the staff of the Institute of Mechanics Technology, Szczecin Polytechnic (10 programs) and the Institute of Machine-Building Technology, Wroclaw Polytechnic (6 programs).

During the second stage of the work on the software package, standards were developed for data-input, data-revision, and calculational techniques, as well as for the principles of program development. These standards preclude, in principle, the possibility of committing formal and manual errors by the user, so that the software thus developed can be used by persons lacking any experience in work with computers.

The maximum simplification and standardization of the rules for using the software package practically dispense with the need to train users. Whoever has but once observed that software in operation or utilized one of the programs himself, can at once commence using the other programs. The appended instruction manual is of help chiefly to data preparation.

The foregoing software package will be applied in 1987 at the design office of the DEFUM Machine Tool Factory in Dabrowa Gornicza and at the KOPROTECH Research and Design Center in Warsaw.

Systems for Analyzing Dynamic Properties of Machine Tools

Developing the dynamic properties of machine tools is one of the most important and difficult problems involved in their design and production. The importance of this problem is due to the fact that dynamic properties affect markedly such operating characteristics of machine tools as productivity, precision, and durability. As for the difficulties, they are due to the fact that a deliberate determination of the dynamic properties can be done only on the basis of complex mathematical models of the vibrations of machine-tool elements and assemblies. Under the CPBR 7.5 Program an attempt was made to develop a system assuring the practical accomplishment of this task.

The system being developed will make possible an assessment of the dynamic properties of loadbearing and drive units. The solids-modeling method will be used to simulate the vibrations of the loadbearing units, while the compression-dissipation properties will be simulated by means of discrete compression-damping elements (CDE). For greater precision of modeling, it is assumed that the compressive parameters of CDE will be derived from static calculations. These parameters and the distribution of compressive elements in the models of fixed and moving joints will be derived with the aid of programs for analyzing butt joints and screw joints, while the parameters modeling the shape rigidity of frames will be derived from calculations of design parts by the solids-modeling method. As for the simulation of drive units, geometric constraints modeling the meshing of gear wheels will be imposed on drive-shaft models. In

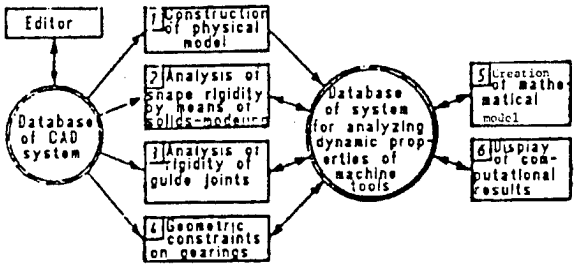

Figure 3. Structure of System for Analyzing Dynamic Properties of Machine Tools

addition, the possibility of **integrating models of the vibrations** of loadbearing and drive units is assumed, which will make it possible to analyze machining stability after the software is further expanded.

The structure of the system for analyzing dynamic properties is presented in Figure 3. The system, consisting of six modules, will work together with the CAD-system database containing the geometry and physical parameters of the assemblies. As derived from calculations with the aid of modules 1 to 4, the structures of the models and their parameters will be, along with the dynamic characteristics derived from the solution of the models, stored in the local database of the system. Owing to the difficulty of unambiguous analysis of many dynamic characteristics, the system will make possible a graphic display of calculational results in the form of animation of the vibrating machine tool with respect to the indicated resonance frequencies occurring within the range of the actual loads exerted by cutting forces on the components. This will markedly facilitate identifying the weak spots of the design relative to dynamic properties.

The system for analyzing dynamic properties is being developed by the Institute of Mechanics Technology, Szczecin Polytechnic, and the Chair of Mechanics and Principles of Machine Design, Gdansk Polytechnic.

System for Strength Analysis of Machine-Tool Housings

This system will make possible a broad strength analysis of intricately shaped machine-tool housings with allowance for fixed and moving joints. Since in most cases machine-tool housings have a closed-end design in the nature of thick-walled covers with stiffeners (having arbitrary spatial configurations), it is assumed that the system will be based on the solids-modeling method, with the following types of solids: rod, beam with allowance for shear, disk, and thick coating (BDS element). A contact solid will be developed for simulating joints.

The system will consist of many autonomous modules linked by disk ensembles. The principal modules are:

- data-input editor;
- graphic modules for visualizing and drawing the model;
- model-grid and load generators;
- a module for optimizing the half-zone of the rigidity matrix;
- solids-modeling modules;
- graphic modules for visualizing and diagramming displacements of kinematic pairs and stresses in components.

These methods for calculation of housings (with allowance for joints) will be experimentally verified. The system is being developed at the Research and Development Center for Principles of Technology and Machine Design in Warsaw.

System for Analyzing and Optimizing Thermal Displacements of Machining Centers

This system is designed for assuring desired thermal properties of machining centers. It will make possible the assessment and optimization of the thermal properties of discrete subassemblies and the entire design with respect to power loss in drive units, temperature diagrams, and thermal displacements. The optimization of heat criterions is intended to facilitate the selection of the optimal structure and parameters of both the drive units and the frames.

This system will be developed with the aid of the software for thermal calculations of machine-tool assemblies developed in earlier years by the Institute for Machine Building Technology, Wroclaw Polytechnic. During the first stage of the work on this system, that software will be modified to allow for the characteristic features of the design of machining centers and enhance the accuracy of calculations. The enhancement of calculational accuracy will be primarily linked to the broadening of the heretofore used mathematical models so as to allow for such thermal effects as heat transfer in the closed spaces of the housing, across housing walls, and across the casings of liquid-cooled bearings, as well as the forced convection due to the operation of the belt transmission.

In addition, the system will make possible the calculations of structures (whose elements are made of different materials) and allow for boundary conditions in the form of specified values of temperatures and displacements and for the presence of fixed and moving frame joints. Computer graphics hardware will be used to input data and display results. The system is being developed at the Institute of Machine Building Technology, Wroclaw Polytechnic.

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Future Plans for Databases, Networks in GDR, CEMA S&T Information Networks

23020009a East Berlin RECHENTECHNIK UND DATENVERARBEITUNG in German Mar 88 pp 12-14

[Article by Franz Kneitschel, Central Institute for Information and Documentation of the GDR: "Aspects of Developing a Network of Automated Information and Library Services of the GDR"]

[Excerpts] When looking ahead to the year 2000, it is our mission to do everything to accelerate the development, production, and use of key technologies such as microelectronics, robotics, and biotechnology. This is also the strategic objective of the information and library network of the GDR which is being developed in close connection with the Network of the International System for Scientific and Technical Information (ISWTI-network) and on the basis of the International System for Automated Information Exchange (ISAI) of the CEMA-countries. Its implementation is intended to have scientific-technical information make a gradually increasing contribution to the development and implementation of ambitious goals in research and technology, to the economic utilization of scientific findings for production renewal, and to a rapidly spreading scientific-technical progress in the national economy.

The network is to be set up as an open system, so that it will be possible to react to rapid changes in international information resources and information and communication technologies. Further, the national network must be tuned to the developments in the International System for Scientific and Technical Information and in the International System for Automated Information Exchange and to international standardization guidelines. Therefore, the next major steps in the development of the network are as follows:

—An initial phase until 1989 with a pragmatic orientation in which selected existing databases of the GDR will be transferred to centers for the processing of databases having limited capacity and where an experimental interactive information supply will be achieved by means of a terminal network via line-switched data networks. At the same time, design concepts for the network will be worked out and preparations will be made.

—Expansion of the experimental information supply with remote access to databases, development and start-up of a pilot application network with a packet-switched data network by 1992, and subsequent transition to full operation of the information and library network of the GDR.

Rapid Expansion of Remote Information Locations and Automated Information and Library Workplaces

The information resources of the network will affect the supply of information to key industries more favorably if the largest possible number of such automated information and library workspaces are used as network terminals, if the distance between such subscriber locations and users is as short as possible and if the present information and library facilities will also fulfill the functions of remote information locations. For purposes of orientation we use the distribution density of the R&D cadres in the national economy as a basis and proceed from the assumption that initially at least one subscriber site in the network of scientific-technical information would be required for each 1000 R&D cadre. In the next few years, several hundred remote information stations will become operational in the GDR, with terminals based on 8-bit personal computers, e.g. the PC 1715 W with dot-matrix printers K6313, which will work together with various databases with remote access in an automated information exchange in an asynchronous or synchronous mode using the line-switched data network of the GDR and via ISAI.

If appropriate on-line databases are offered, each one of these remote information locations has basically the search potential of a current average automated information service of the GDR—i.e. several hundred searches per year, the only difference being that the remote searches can be done by these services as needed and can cover topics beyond the basic subject core of such services.

Another feature of such remote information locations which is very important for accelerating the availability of sources is the remote ordering of copies during or subsequent to an interactive search, or when the source data are known, also as a separate ordering process at the terminal.

At present, it is not even possible to estimate the potential effect of the participation of remote information locations in the system of electronic mail and teleconferences of VNIIPAS (Union Research Institute for Automated Application Systems of the USSR) to improve communication with research collectives which participate in the contractually established cooperation within the framework of the complex program. This clearly goes beyond the traditional work areas of automated information services: They no longer trade only canned information, but also "fresh" information.

Beyond these benefits within the network there are immediate benefits such as an increase in efficiency of the remote information locations in autonomous operation, because this automated information and library workplace which opens up network resources is also useful as a microsearch system for registering check-outs and many other processes in the internal operation and administration of information and library facilities.

The ingenuity of personal computer users is great which results in problems of determining which standard solutions guarantee the continuity of data formats and technological lines in the cooperative establishment of databases without slowing down the many initiatives. In this

context, the modular software package MI-DOS/EAW for PC 1715 proved to have particularly flexible applications and be user friendly and rugged.

Generally, the development of terminal networks can be characterized as follows: The larger the number of users which are able to remotely access data bases based on daily experience and who are familiar with the content of the databases or the possibilities of automated information exchange, who are familiar with the use of the technology and software, the more favorable the economic framework for the database and network operation and the greater the benefit to the national economy in the GDR and in the CMEA.

Increasing Information Value of Databases by Network Operation

With the establishment of the information and library network of the GDR the constant process of adaptation of automated information services to the internal and external conditions of the scientific and economic events will be continued with a new quality. The first objective is the selective integration of the information resources and the source material of the more than 100 automated information and library services of the GDR which is available through these information resources. In selecting and evaluating the databases in the GDR, which increase annually by almost one million documents and graphs, we can rely on an information demand level and structure which has developed over more than a decade, however, we must consider that the degree to which the demand is being met is essentially limited by the economy and technology of the batch operation of automated information search systems of the type AIDOS/DOS/OS on ESER-installations.

Some of these services which meet the special requirements of their combine or branch very well, but are of little use to the outside, are naturally not primary candidates for being accepted into the central database operation. However, they should also be checked as to the manner and extent to which they would have to be integrated into joint usage, when direct connections between operations of the GDR and the USSR or other socialist countries will be developed, e.g. via automated information exchange.

These services will become more specific and powerful as the microprocessors advance further in the area of science and production, and will be particularly evident in cooperation with CAD/CAM/CIM solutions. However, the necessary data interfaces must still be developed and must be standardized at considerable expense.

Many automated information and library services meet the demand from several branches, some meet the demand of the research and production of the GDR as a whole. This includes, for instance, development and application of computer technology, microelectronics, and material characteristics. For these services, network operation can facilitate access to the databases for many users from a great variety of fields so that the actual demand and thus the utilization rates in remote access can increase correspondingly rapidly. For material characteristics or other stored facts where language is not a great barrier, a rapid increase in international access could also be expected. Thus, the transfer of such databases with an expected increase in the utilization rate to central databases of the GDR will be prepared in order to provide a service to subscriber locations of the GDR and in ISWTI by remote access and will gradually become operational starting in 1988.

Strategy of Database Distribution and Utilization

As comprehensively and rapidly as the national information resources may be documented, evaluated and offered on-line, compared to the establishment of databases in the USSR and in the ISWTI or their emergence worldwide, and particularly if they are divided into the main lines of science and technology and key industries, it soon becomes clear that on a national scale only temporary solutions can be reached.

Long-term solutions require international cooperation. In ISWTI, for instance, the strategic concept of the International Source-Oriented Information System (IQIS) is applied and implemented for the complete listing, documentation, and offering of all types of sources.

With the centers for the processing of databases of the International Information System for Published Documents (MISOD)/Union Institute for Scientific and Technical Information (VINITI), International System for Patent Information (MSPI)/National Production Association "Recherche" (NPO "POISK") and IQIS WFA/ISWTI a great step has been made towards the experimental supply of information for IQUIS by remote access. In the system organization of ISWTI listings of foreign publications, i.e. the scientific-technical library catalogs as a basis for making sources available and in particular for remote ordering of sources in the ISWTI-network, are still incomplete, although magazine catalogs of the USSR, People's Republic of Bulgaria and the CSSR can already be obtained through remote access.

On an international scale, the establishment and provision of complex databases capable of supplying large amounts of information to main lines of science and technology and to key technology in the ISWTI-network is still in its infancy; furthermore, the necessary concept has not yet been clarified. IZWTI has provided a valuable basis for the solution of these issues with its concept of a "complex data base" for energetics which it has been testing both in content and technology over many years. Hasn't the time come to develop a collective concept in the ISWTI which will support planned cooperation and

division of labor in the establishment, operation, and utilization of complex databases and in the operation of corresponding centers for the processing of databases (ZVD)?

Based on the complex program it is imperative that groups of valuable databases must be established in particular for key technology tasks, which are outstanding with regard to completeness and retrospective depth, timeliness and quality of remote access and which offer a high proportion of scientific-technical and technical-economic facts, of product and market information, software, and others using practically all types of sources for the development, production and application of key technologies. A good strategy for developing the ISWTI-network should be aimed at guaranteeing any subscriber site almost assured access to the most important databases; i.e. such databases must be offered several times, at least twice in the network. Thus, database automation and radio electronics could definitely be offered by the manufacturer MISOD/VINIT and at the same time in a complex database for the key technology microelectronics.

On the other hand, the duplication rate of databases in the network must not be too high, since this would take up expensive memory space and processing capacities of the centers for the processing of databases unnecessarily or with only limited benefit. Even if one could already assume the existence of a multi-branched terminal network, it would take three to five years until the actual rates of increase in the use of newly established database centers would make a significant and noticeable contribution to the national economy. A medium-sized, rather well-established database center, INKA in the FRG, had, for instance, approximately 30,000 searches/year in 1985 with an operating expense of approximately DM 37 million and with 10 million documents on-line, and was able to recover approximately one fourth of its expenses. In 1985, the actual average capacity of this center was approximately 15 searches/hour.

Using the projected information requirements of the GDR of 200,000 remote searches/year as a basis, this would result in an average network load of 100 remote searches/hour by mid-1990. According to present experience with database operation, in the coming years it will seem to be possible to implement centers for the processing of databases based on ESER-technology with an average capacity of 25 remote searches/hour (with peak loads of 125 remote searches/hour). In numerical terms, this means that with an average network utilization of 100 remote searches/hour the capacity of four centers would be required for processing the databases. The basic demand of the GDR could be met by two to three domestic centers for the processing of databases (ZVD), and the remaining demand which covers a wide range of subjects could be covered by the equivalent of one to two ZVD in the ISWTI network. The mutual remote access to ZVD alone would mean that the GDR would need 20 to 25 low-speed transmission channels for automated information exchange in ISAI.

Microcomputers and Packet-switched Data Networks Create New Conditions for the Cooperative Establishment of Databases

The increasing use of 8-and 16-bit personal computers in information and library facilities results in new technological requirements for the automated information and library services of the GDR.

So far, medium-sized services of this type which select, edit, and machine-process approximately 10,000 documents per year and which process inquiries and disseminate means of information for several hundred user facilities, require approximately 300 hours of ESER/computer time/year. If in the future, these automated information and library services will use one to two 16-bit personal computers and three to five 8-bit personal computers 2 to 3 hours per day for the cooperative generation of their database, the degree of division of labor among the partners in industry, academy, and universities, the quality of editing and data registration can be increased, and the time period from receipt of the source by the subscriber to its announcement and availability can be reduced considerably. For six months the master file can even be kept on a 16-bit personal computer with a hard disk, or the complete file can be uploaded to more powerful computers of the SKR or ESER line. From this location, partial databases which are very relevant for the national economy can be uploaded to ZVD, and such very specific databases can be exchanged with certain services, or they can be downloaded to remote information sites for further transmission to the end user.

With this goal in mind, so-called network workstations are to be established, which will fulfill such functions on the basis of personal computer ES 1834/35 and the AIDOS/M16 software; they will also have adequate means for pre- and postprocessing of searches. In this context, the concept of the automated workplace of an information coworker (ARMIR) of the Union Research Institute for Automated Application Systems of the USSR (VNIIPAS) is of particular interest.

However, such personal computer solutions for cooperating partners from different territories cannot be expected until a reliable and efficient data transfer service between them can be used on the basis of the packet-switched data network of the GDR and its connection with the ISAI. At that time, the present great obstacles of distance and time facing the cooperative establishment of databases on an international level might also be reduced.

Risk Reduction in the Development of Information Networks

In view of the rapid succession of 8-, 16-, and 32-bit computers, local networks and their connection to telenetworks, the rapid development of memory on magnetic disks and cassettes in the gigabyte range, optical storage media, in particular CD-ROM-technology (Compact Disk - Read Only Memory: Laser-optic mass storage, 4.75 inch disks contain approximately 550 MByte gross capacity), the issues concerning the useful life of technological solutions, their upward compatibility become crucial again.

However, it is most important to relate the rapid technological development to the speed with which standard technology and software is being disseminated in all areas of the national economy and in particular in its effect on such a complex system as scientific information.

If the CD-ROM line continues to be successful and if therefore an inexpensive and durable dissemination and search medium for large databases would be available in the nineties—comparable in cost to the printed report magazines, decentralized efficient search locations for key technologies could be established with the use of 16-bit personal computers and SKR-technology.

Therefore, the economic cost and the risk of operating complex data bases for key technologies would be drastically reduced, and sufficiently large facilities could be their own suppliers for certain key technologies—if the material does not have to be completely current, but can be between three to 12 months late.

Do ZVD and information networks have longer-term prospects under these conditions, or are they only temporary phenomena which will not survive the year 2000? If we look at the considerations described above, the range of action of such ZVD seems to be clearly limited to the current year. At the same time, however, every new item can be completely up-to-date, i.e. when a new source comes out it can be made available immediately via the network, even in full text if required and if an integrated services digital network (ISDN) is available.

If there are stringent requirements as to the search quality, the complex interconnection of several large databases, the search speed, and if it is also necessary to ensure specific further processing and analyses of the search results, it seems that ZVD based on powerful large-scale search systems will continue to be indispensable.

These aspects alone indicate that the development risk for our information network in CEMA requires joint efforts in many directions. The more thought-out and collective the concept of international socialist division of labor, the better we will succeed in perfecting further cooperation in ISWTI and ISAI and to have scientific-technical information and scientific libraries make an increasingly larger contribution to the socio-economic development.

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GDR's Robotron Combine Develops New Data Base Software

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[Article by Dr. Rolf Heinemann, VEB Robotron-Project Dresden: "Development of Databank Software in the Robotron Combine"]

[Excerpts] The great importance of database software for the development and implementation of integrated EDP-application projects has now become an internationally recognized fact. Hardware producers as well as software houses are taking this fact increasingly into account. In the Robotron combine, for instance, research and development efforts for providing database software have been included since the early seventies. Systems such as DBS/R, DABA 1600, REDABAS and AIDOS were made available to the GDR economy, in particular for the hardware spectrum of the Robotron combine.

Database Software Offered in the GDR

In addition to the database systems offered by Robotron many different systems of other developers are being used in the GDR. For a broad-based reuse, systems such as TOPAS and DAFEMA by the Data Processing combine should be mentioned in addition to those offered by Robotron.

An analysis of the database operating systems available shows that their efficiency is equal to those systems which are being used internationally. With regard to the present state of the art, however, the following limitations must be recognized;

—there is no compatibility between the user interfaces of the systems (change-over problems, qualification expense, and more).

—there is a contradiction between the complex features the systems offer and the range of functions required for specific applications, since the available products can only be used as a whole unit (efficiency aspects, acceptance threshhold, and others).

—None of the available systems meets the requirements of maximum portability for utilization with a great variety of operating systems and hardware solutions.

Neither has the multilevel architecture been implemented which is considered to be essential for implementing data independence.

—The available systems do not include one for minicomputers and office computers which would support the network-oriented data model.

With regard to CAD/CAM application it should be noted that the available systems meet the necessary requirements only partially.

A considerable disadvantage of the available systems is the fact that the DBBS architecture has no uniform interfaces. With these interfaces it is not possible to offer the services required by the respective user classes. For CAD/CAM application the emphasis in the work with database operating systems shifts from process-oriented processing to product-oriented processing. The CAD database requirements are generally determined by the storage of geometrical and technological data. Since we are talking about very extensive data blocks the technology to be used is of particular importance. It has not yet been shown whether the relational solutions offered for workplace computers meet the CAD requirements, since neither the experience nor the results of preliminary work are available in the GDR.

With regard to information search systems as a special branch of database software, at present the GDR uses primarily the AIDOS-systems (AIDOS/DOS, AIDOS/OS, AIDOS/VS) on a large scale. WIth AIDOS/VS emphasis is now on the most modern product of this line. AIDOS/M8 and AIDOS/M16 which are compatible with AIDOS/MS are now being offered as solutions for personal computers. Both AIDOS/M8 and AIDOS/M16 can be used as a data acquisition or data preparation system for AIDOS/VS.

The increasing availability of data terminals, in particular intelligent terminals, results in a correspondingly greater demand for data communication systems for these devices. With regard to their online connection in a DFV-network and thus distributed data processing the individual systems must be compatible with each other.

It is estimated that the DAKS line offered by the Robotron combine can solve only part of the overall problem.

However, with ESER, data communication can be implemented to a limited extent by using TSO and observing certain conditions.

New Database Software

In addition to the known systems, this year the Robotron combine will make available database operating systems for 32-bit computers as well as REDABAS-3 as an expanded version of the familiar system for the 16-bit line. In the continued development of database software emphasis is placed on making available a multivalently usable, modular database operating system (INTERBAS). The development of this system is coordinated with the USSR and the major partners in the GDR. The strategic significance of the database software led to the same realization on both sides, namely to create a base system supported by source programs, although this means additional expense. INTERBAS will be designed taking into account the multi-level architecture and the simultaneous existence of various suitable data models. It will be implemented as a portable DBBS of configurable elements. This results in uniform utilization possibilities for the various computer lines.

All computers produced in the Robotron combine starting with a 16-bit processing range will be supported, and the operating systems OS/ES, SVM, MUTOS, and DCB will be taken into account. Smaller versions of INTERBAS are supposed to be operational in installations starting with a 256 HS size. Frequently, the users' information processing systems utilize very different computers. In this context, the uniform utilization of DBBS functions is an important factor affecting the increase in efficiency irrespective of the degree of coupling. From the various modules, the user can build up a custom database operating system which allows a descriptive or procedural mode of operation and effectively supports its application within CAD/CAM systems.

The modular character of the overall system is a prerequisite for the synthesis of database capacities which currently can be covered only by using several DBBS. The developer has the possibility of providing the software in steps, and if possible he can also use components of model systems. The module interfaces will be determined so that individual modules can be exchanged in the course of scientific-technical progress. Further, INTERBAS is characterized by data independence never obtained so far, durability, and user friendliness. INTERBAS must be developed as the top product which is to ensure the transition to a DBBS of the fifth computer generation.

Although the capacity of the first stage of INTERBASE described is composed of features in a new system structure which are already known internationally, the following should be emphasized:

—INTERBAS makes it possible to use one and the same database both relationally and with network operations without requiring reloading among various DBBS.

—The efficiency of relational operations can be increased considerably by the fact that internal network structures permit the improvement of Join-implementation.

—When using flexible mapping possibilities almost all efficiency-oriented changes to the internal structure of a database can be carried out without affecting the conceptual object. Thus, data independence reaches a new level.

In addition to INTERBAS, in 1989 another development stage of the well-known system REDABAS will be made available under the name REDABAS4.

In the field of information search systems, the emphasis will continue to focus on using AIDOS/VS which has been systematically expanded and upgraded to AIDOS/VS II. AIDOS/VS II features functional expansions (detail searches, automatic indexing, additional editing functions, interface to AIDOS/M) as well as adaptation to the OC-7 operating system with VSAM-II. With AIDOS a product line was created which guarantees consistent application within the computer hierarchy provided by the Robotron combine.

With the development tasks listed, present database software will be upgraded with new hardware and software products. The new developments are geared to the new hardware products or expand the application options of existing hardware and software solutions.

Meeting the requirements of CAD-systems completely remains one of the major goals of the database strategy of the Robotron combine. At present, CAD-problems on workplace computers are primarily implemented by using simple means of data management (operating systems) both nationally and internationally. Since no preparatory research has been done concrete developments cannot yet be included.

Requirements relating to CAM-problems are being solved with existing and upgraded solutions on host computers, in particular by DBS/R. Development work on distributed processing has been started. The logic transmission protocol provided by developers using the DFV-transmission procedures present in ESER with its products DAKS 2.0, DCS-1600 and DAKS-SIOS or DAKS/SCP provides distributed processing covering three computer hierarchy levels. Ensuring data integrity across these computer hierarchy levels while using the logic transmission protocol is still up to the user. The use of distributed processing of database solutions while protecting data integrity will not be possible until further major hardware and software requirements have been implemented.

Preliminary and Research Tasks

A good indication of the strategic importance of database software is its use in many central projects which are economically and politically important. This makes it imperative to make this software line stable and independent by carrying out one's own developments, as well as preliminary and research tasks.

Furthermore, this necessity is confirmed by the broad and differentiated hardware spectrum in the GDR and the danger of expanded embargo regulations in the computer science sector. Since database software—and database operating systems in particular—have become standard as a basis of integrated application solutions, the requirements for these products have also increased. Future developments are determined by requirements such as standardized interfaces, modular construction, portability, flexibility, comprehensive data protection and data protection measures.

In summary, the database software requirements for the nineties concentrate on the following goals:

—Meeting the information demand, i.e. responding to any inquiries of authorized persons or systems from any desired location to databases of any size without any physical and structural limitation in natural language—to the extent possible—and in the shortest possible time. In addition to the research tasks regarding database operating systems the requirements for future information search systems must also be considered. This requires tasks such as:

—Automatic content analysis and display of full texts,

—Methods for analysing and storing graphic information,

—Establishment of special processors and memories for content-addressed retrieval of information having variable lengths,

—Studies regarding fast mass storage media for full text and image storage in the gigabyte range,

—Technical means for automatic input/output of graphic and image information—automatic language input/output,

—Architecture of information search networks.

DC-system tasks include:

—Proposal of a standard for the application layer in OSI-networks for connecting DC-systems, in particular DAKS, to the public data network;

—Model for evaluation performance analyses of distributed DB/DC systems.

In its future development the Robotron combine expects and is ready for greater demands. This requires concentration of available capacities while at the same time taking into consideration the broad range of requirements. Such a task can only be solved together with the Academy of Sciences and the capabilities of the university and professional school systems which must carry out a considerable amount of research, basic research in particular

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Robotron Makes Presentation at Hannover Fair in FRG

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[Text] Hannover, 23-24 Apr—The Robotron Combine VEB of Dresden is making an appearance at this year's Hannover Fair for Industry as a new provider of solutions for CAD/CAM problems.

User-oriented systems for various different fields are being presented as part of a joint exhibition with the GDR's Ministry for Electrical Engineering/Electronics at the "Microtronics" division of the fair. The goal aimed at is for the name "Robotron" to become associated not only with typewriters and printers, but also with computer systems, according to what the deputy general manager of Robotron Exports-Imports, Dr Reinhard Voigtlaender, said at a press conference.

Robotron is fully aware of the difficulties of entering into this hotly contested market in the FRG. Therefore Voigtlaender was reserved with respect to predictions about its possible sales prospects. He said that although the company has had promising talks, nevertheless it is just the initial steps in the market that are difficult. He said that if good sales chances should emerge, and this is the assumption, then for marketing purposes the company will ally itself with a highly competitive FRG partner—possibly a software business.

The first target group for Robotron is made up of companies just getting into CAD/CAM. Mentioned by Voigtlaender as significant arguments suggestive of its ability to compete are hardware that is compatible with other systems and available at competitive prices as well as software offerings both from Robotron's own software division and from cooperation partners in the GDR.

Last year Robotron was able to increase its value of sales in the FRG—mainly involving typewriters, printers, and mensuration electronics—by about 25 percent, to roughly DM 40 million. Its marketing partner for the FRG is the firm of Grubert Importers and Agents, Murnau, to which 500,000 typewriters had been delivered by the end of 1986. For 1990, about DM 60 million is being envisaged as the sales target for the FRG.

This combine, with 20 enterprises and about 70,000 employees, increased its total sales last year by about a fourth, to roughly 6 billion GDR marks. Between 65 and 70 percent of total production is exported, and in turn 50 percent of these exports goes to the USSR. Thus, for example, Robotron outfitted the Soviet state-owned central bank (Gosbank) with EDP systems and equipped its branch offices with terminals.

More than 10,000 personal computers are delivered annually to the Soviet Union. Of its total exports in exchange for convertible currency, about 50 percent goes to the FRG. Voigtlaender mentioned France, Great Britain, Benelux, and Austria as other important markets. But by now also the 1 millionth typewriter using an Arabic keyboard has been delivered, with 600,000 units having been sold to Egypt alone.

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